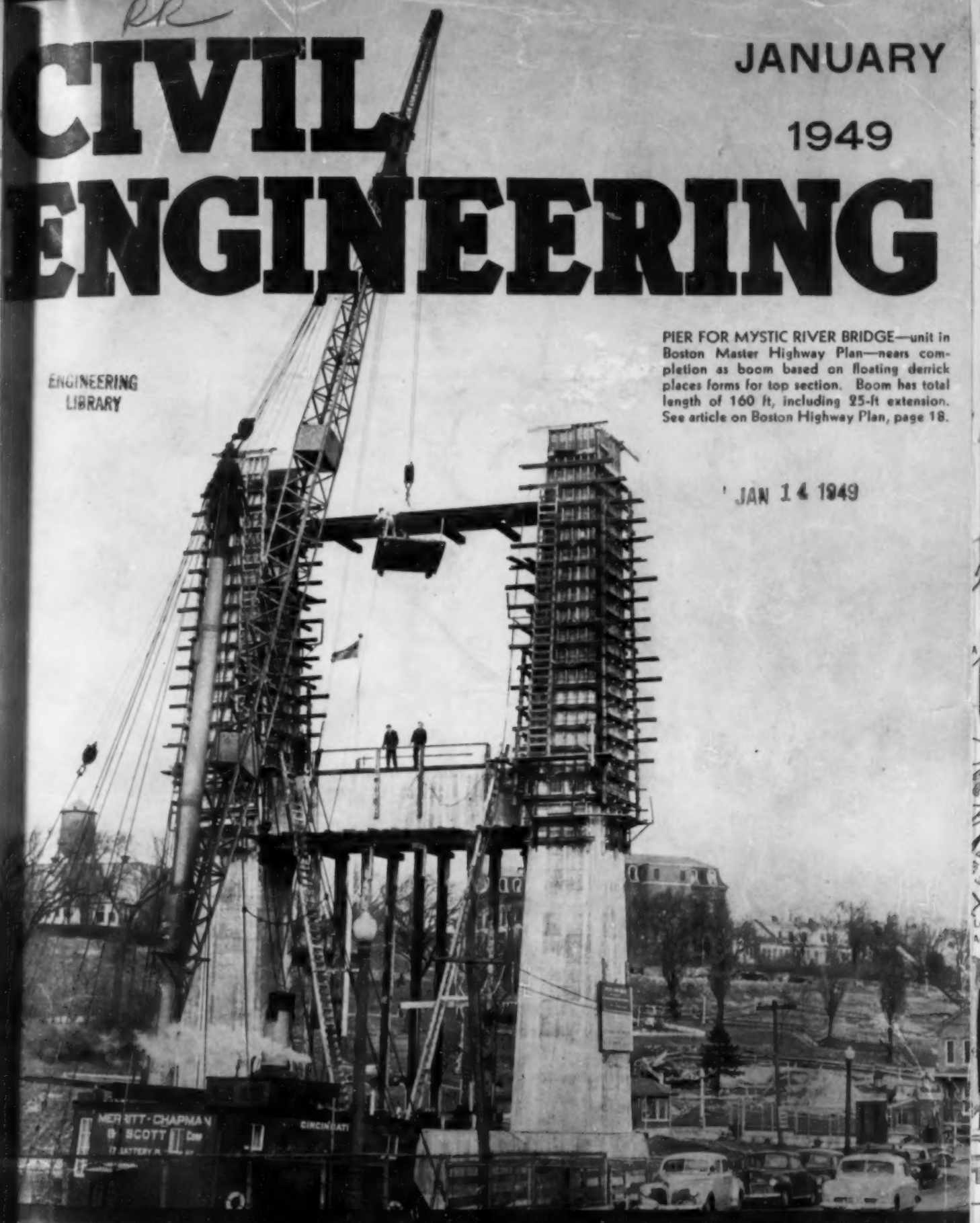
CIVIL ENGINEERING

JANUARY 1949



PIER FOR MYSTIC RIVER BRIDGE—unit in Boston Master Highway Plan—nears completion as boom based on floating derrick places forms for top section. Boom has total length of 160 ft, including 25-ft extension. See article on Boston Highway Plan, page 18.

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Construction Cost Control Shows Efficiency of Men and Machines—Maxton Engineers Tackle Perplexing Problems in Frozen North—Spofford, Hyland, Mellish New York Builds Two New Sewage Treatment Plants in Far-Sighted Program—Gould Contractor Meets Close Design Tolerances on Building Arch Bridge—Pollvka

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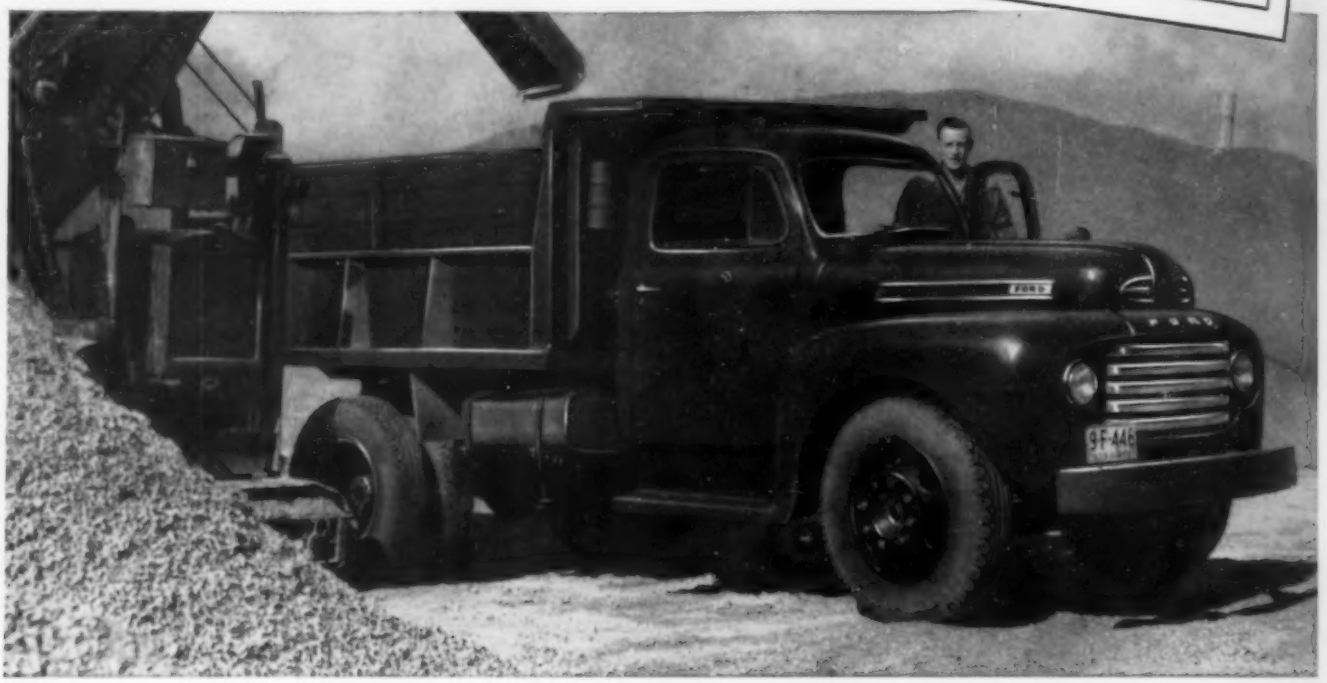

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- ★ Nationwide service from over 6,400 Ford Dealers.
- ★ Ford Bonus Built construction for long truck life.

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CAREFUL PLANNING of plant and field organization facilitates analysis of operating costs. Direct routing of aggregate and cement to Madden Dam (C.Z.) mixing plant makes for economical production of concrete. In this view from top of head tower during construction, aggregate classification plant is seen at far left, with conveyor system feeding sand and gravel to concrete mixing plant at right. Cement silo is in right foreground.

Construction Cost Control Shows Efficiency of Men and Machines

H. P. MAXTON, M. ASCE
Secretary–Assistant Treasurer, Raymond Concrete Pile Co., New York, N. Y.

CONTRACTORS MAY LOSE money on contracts for a variety of reasons beyond their control but probably the most common reason for losses is lack of efficiency in management and supervision. The importance of cost control in preventing losses of this type is generally recognized but the basic procedures and principles of good cost control practice are less well understood. In order to clarify the subject a manual is under preparation by the Construction Division's Committee on Basic Accounting Procedure and Cost Control, of which Mr. Maxton is chairman. In this article, which he originally presented before the Construction Division at the Boston Meeting, Mr. Maxton presents an outline of the manual and discusses the fundamental principles of cost control as they relate to the construction industry.

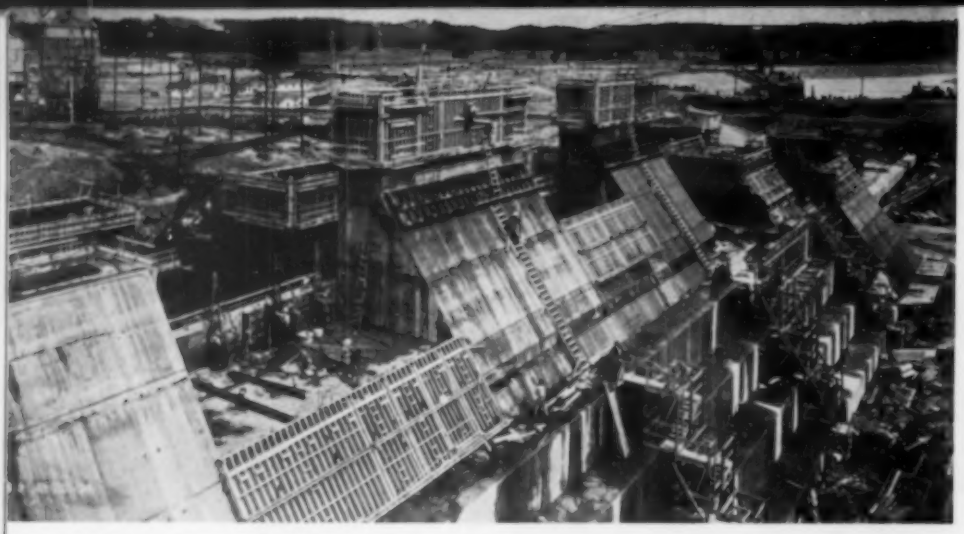
NO BUSINESS can long survive without a knowledge of costs and an intelligent control of costs. Cost control is no less essential to the survival of contractors than of any other business. However, the technique of cost control is somewhat different because an industrialist can gradually increase or lower prices to assure profits or survive competition, whereas a contractor may not survive to take on more business if he loses his all on a fatal contract. Of course, a contract may lose money for any one of a number of reasons, such as low bid, insufficient knowledge of conditions, increase in labor and material prices, and poor selection of construction plant and equipment. Sometimes adverse weather and flood conditions also contribute to losses, especially on heavy construction operations, but perhaps the most common form of loss is just plain inefficiency of management and supervision. Most certainly a keen, live-wire, intelligent management will not permit this last-mentioned element to enter the picture.

Cost Keeping and Bookkeeping

Cost engineering is as old in practice as is construction for profit; its recognition as a studied art, however, goes back no farther than the beginning of the century. The distinction between cost keeping and bookkeeping should be emphasized. The one is a system of showing in money values the efficiency of workmen and machines; the other is a means of recording debits and credits.

Common conceptions of cost engineering are confused because the fundamental function gets befogged in the working processes. Bookkeeping, cost keeping, accounting, reports, records and what-have-you are means to a purpose but are not the real purpose. The real purpose is management of construction to keep down costs and, in contracting, to make a profit. The collected figures and records give the cost engineer the knowledge of the economics of operations and performance by which he assists or advises in planning plant installation, processes and working schedules that will reduce costs of current and future work. Because on all construction jobs, questions constantly arise as to how certain operations can be conducted most efficiently, one of the most important functions of the cost engineer is to advise with the construction superintendent and the management on the most economical methods of doing work.

It is generally agreed that cost control is important but that the know-how is foggy. In order to clarify simple procedures for cost control, the outline of the manual now being prepared by the Construction Division's Committee on Basic Ac-



FOR MASS CONCRETE PLACING JOB, cost engineer sets up analyses of specific operations such as chart for unit cost of concrete (Fig. 2). Construction view at Watts Bar Dam site (TVA) shows west side of lock river wall in foreground and, in distance, mixer plant and part of lock approach channel.

counting Procedure and Cost Control is given below:

1. The System of Control of Costs
   What is it? Use and value of reports, charts, analyses, etc.; their design, method of presentation.
2. The Cost Engineer
   His qualifications, experience, duties.
   The answer to the question that may be raised, "Why give so much importance to the qualifications of this man?" is that to a large extent the success of the cost control program is influenced by the selection of proper personnel just as surely as the success of a job is assured by the proper selection of a construction superintendent.
3. The Estimate
   Preparation of
4. The Accounting System—
   Books of Account
   Why accounting?
   The accounting system
   The books of account:
   General ledger
   Cost ledger
   Subsidiary ledgers
   Inventories and inventorying
   The cost statement
   Statement of operations—profit and loss
5. Cost Engineering
   Preliminary work—study and preparatory work by the Cost Engineer of:
   The contract
   The estimate
   The construction progress schedule
   Estimated income
   The budget—contractor's investment
   Estimated profit
   Development of the classification of accounts
   Its purpose
   Basis of design
   Distribution of Costs
   The inventory
   Quantity survey
   Work done
   Units of construction
   Regular reports (daily, weekly, monthly)
   Analyses and graphs
   Special studies and analyses
   Monthly estimate of total probable cost
   Revised estimate of profit or loss
   Statements to management
6. Financing a Contract
7. Taxes and Tax Problems

"The Accounting System" and "Cost Engineering" will be briefly discussed herein but it will be necessary to omit any discussion of "The System of Control of Costs," "The Cost Engineer," and "The Estimate," as well as the all-important subject of "Taxes and Tax Problems." The matter of taxes is one for the firm's treasurer to handle and its proper treatment will be a means of saving many, many dollars. Lack of knowledge and unintelligent handling of tax problems is a bottomless pit for losses, often unrealized by the top management.

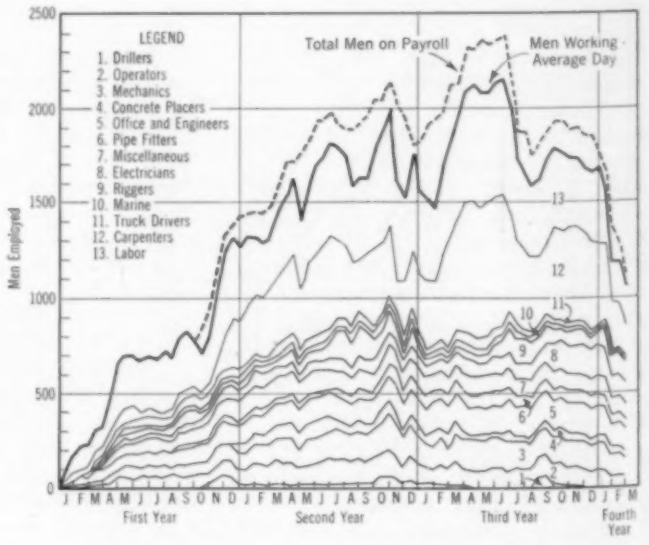


FIG. 1. TOTAL CONSTRUCTION FORCE REPORT shows very easily, and at expense of few minutes a month, pattern of men on payroll throughout progress of job.

The Accounting System

Every business man, and a contractor is most surely a business man, would understand what an accounting system is and what it is supposed to accomplish. He does not need to know the details of accounting other than to understand its fundamentals and to insist that it be reduced, in his business, to its simplest denominator. First, he should have a good accountant in his organization. This accountant will set up the general ledger, cash book, journal voucher register and other necessary general accounts.

There should be an equipment ledger which will provide information regarding the type of equipment, equipment number, from whom purchased and date of purchase, size, capacity, original cost, and a record of rental or use rate. The record should show the estimated life in years or work hours and rate of depreciation. Then there should be an equipment operating ledger in which to maintain operating costs including major repairs or overhauls for each piece or group of like major equipment. Often, and perhaps easier where the books are kept on the job, Clearing Accounts are used in lieu of the equipment operating ledger.

The *general* accounts (as distinct from the cost accounts) will follow the same pattern regardless of whether they are kept in the home office or whether a new and complete set of books of account is set up at the job site for a particular job. These accounts will give the contractor such necessary information as the current

EFFECTIVE COST CONTROL requires frequent consultation between cost engineer and planning engineers and superintendent regarding construction methods, progress, plant and costs. In view looking into site of powerhouse for Guntersville Dam (TVA) during construction, completed spillway section appears in center distance and, at left, top of lock and mixer plant above cells of cofferdams. Concrete travels by belt conveyor along downstream side of spillway. Large rock excavation job in foreground is for powerhouse foundation.

status of his bank balance, how much he owes, i.e. accounts payable, and how much others owe him, i.e., accounts receivable, etc. But they won't inform him if he is making or losing money on his current job or jobs. For this purpose the *cost* accounts are kept.

Cost Account System

To develop a proper and adequate set of cost accounts it is necessary to develop a Classification of Construction Accounts. Assume that there is a detailed estimate—the estimate on which the bid is based. The Classification of Construction Accounts should immediately be prepared, directly conforming to the items provided in the estimate. The classification, item for item, is the basis for the cost accounts. As and when this cost account classification is prepared, consideration must be given and decisions must be made on numerous important points. For example, where is the first cost of plant and equipment to be charged? Obviously it is not always feasible to charge heavy initial expenditures of this kind directly to the bid items.

Then, how and on what basis are plant and equipment costs to be charged or distributed to the work, so as to obtain a true cost of operations? Also, will clearing or suspense accounts be necessary and what are they? How are they to be cleared into the bid items? Further, it is not always possible to charge all material directly to bid items, when it is purchased. Then, what material will be charged to an inventory account and what control will be established over inventory?

An *experienced* (and "experienced" should be emphasized) construction accountant will know what to do and can also prepare an intelligent cost statement and in all probability develop an estimate-to-complete. Such an experienced man is in all probability a pretty good estimator. In fact, he is a pretty good cost engineer since he would be quite familiar with construction methods, material prices, labor efficiency, etc.

Cost Engineer Has Vital Function

But on large construction contracts the construction accountant, even though experienced and wise in all construction operations, has a full-time job handling the accounting and general office functions. To do an adequate job of cost distribution and cost control, another specialist is needed—the cost engineer. Unlike accountant and engineers, the cost engineer is not a product of formal classroom curricula. He may be the product of any course in education, but the engineer usually starts with the best training and background. He only develops into a cost engineer in the school of hard knocks.

As a preliminary to accomplishing effective cost control work on the job he must (1) be thoroughly familiar with the terms of the contract, (2) know what the job is and how it is to be built, (3) be conversant with the job progress schedule, and (4) be familiar with the estimate. The second of these, that is, knowledge of what the job is and how it is to be built, includes a knowledge of many job conditions such as transportation, weather cycles, what equipment and plant has been or will be selected and why, etc. In fact, the cost engineer may have helped resolve many of these problems confronting the contractor in the early days.

The cost engineer then, in consultation with the superintendent and the accountant, prepares the Classification of Construction Accounts referred to above, and most important, is directly responsible for the distribution of all labor, material, and other costs. This distribution is effected by simply marking the proper classification or code number on all pertinent papers. Having done so, and leaving the actual posting in the cost ledgers to the accountant, the cost engineer is in a position to analyze and study the cost currently, each day, to see what makes the job tick and which way it is going.

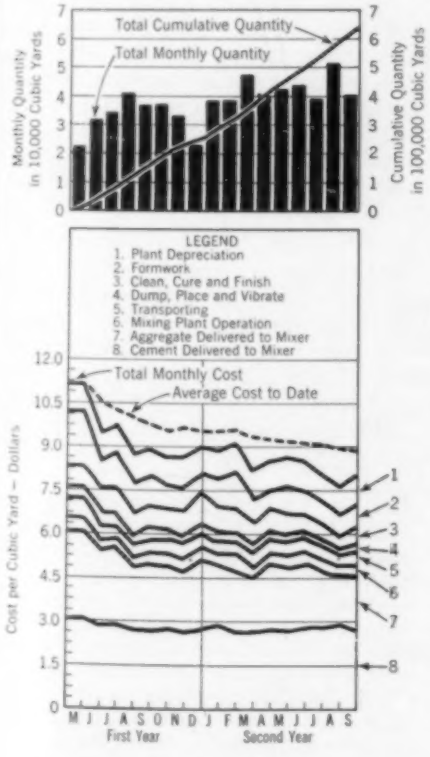

Total Cumulative Quantity
Total Monthly Quantity
Monthly Quantity in 10,000 Cubic Yards
Cumulative Quantity in 100,000 Cubic Yards
LEGEND
1. Plant Depreciation
2. Formwork
3. Clean, Cure and Finish
4. Dump, Place and Vibrate
5. Transporting
6. Mixing Plant Operation
7. Aggregate Delivered to Mixer
8. Cement Delivered to Mixer
Total Monthly Cost
Average Cost to Date
Cost per Cubic Yard – Dollars
M J J A S O N D J F M A M J J A S
First Year
Second Year

FIG. 2. FOR ANALYSIS of large mass concrete placing job, chart showing monthly quantity of concrete placed and cumulative quantity is coordinated with chart which indicates unit cost for various phases of concrete placement.

Costs Must Be Used

At this point the question may be asked, Where is the payoff? That is a good question because all the cost engineer has done so far is *to get ready* to practice cost control, but he has not yet provided the wherewithal to accomplish savings. It is evident that effective cost control is not possible until accurate or true uncontaminated costs are available for any given operation. Then these costs must be *used*.

One of the most important cost reports is the well-known periodic report showing: (1) Actual costs to date of each operation, and (2) the estimate to complete. This pe-

EQUIPMENT LEDGER, part of good cost control system, provides information on type of equipment, number, from whom purchased and date of purchase, size, capacity, original cost and record of rental or use rate; also estimated life and rate of depreciation. Here heavy equipment excavates for river gate structure within first-stage cofferdam at Morelos Dam, now under construction in Lower California–Mexico.

riodic report provides a forecast of the total probable cost. Naturally this cost report becomes more of a reality as time goes on because the actual cost portion increases and the estimated portion decreases. Furthermore, as time goes on, opportunities to save money through studies of the costs of operations decrease. Therefore the earliest studies and resulting job adjustments and corrections are the most valuable. It will do little good to analyze costs and hold postmortems when the job is complete—except to correct errors and cut costs on future work.

Many Different Types of Cost Studies Can Be Made

Therefore it is important to start cost analysis and cost studies as soon as possible after the job gets going. Such studies take many different forms and include labor and force reports (Fig. 1), analyses of specific operations such as concrete placing (Fig 2) and formwork building, equipment studies, time studies, transportation reports, and many others.

To be in a position to advise intelligently, the cost engineer must have a definite program of duties and a complete system of records. In following a planned program the cost engineer may proceed about as follows:

1. Prepare a financial schedule. The management must know how much money is needed to begin and carry on the job, how much and when earnings or income can be expected, and when the earnings can be expected to equal or exceed the expenditures. The banker wants to know how the job was figured, how long his money is needed, and when he can expect the loan repaid. A budget must be carefully prepared and just as carefully followed, for the budget serves as an excellent thermometer of the condition of the job and gives management one of its most important tools for job control. A chart should be designed based on the extension of the estimated unit costs on the progress schedule, and including the expected income and actual earnings (Fig. 3).

2. Review the estimate and the progress schedule, and advise with the planning engineers and superintendent regarding construction methods, progress, plant, and costs. These men must have suitable cost data supplied to them to control their judgment. The cost engineer must be prepared to submit to them illustrative records of construction methods, efficiency, costs, and progress. (See example of progress schedule chart, Fig. 4.)

3. Outline a series of reports to be made to the superintendent. These reports may be of the following classes:

(a) Labor control reports: (1) A record of daily labor distribution, and (2) reports of daily and weekly unit cost.

(b) Detailed cost analyses to be issued periodically or when the progress of the various items of work warrants their preparation. These reports of costs must reflect actual job conditions. A frequent comparison of unit costs with the original estimate or other similar work is a safeguard; too often the constructor suddenly realizes that an operation is absorbing the expected profit and belated steps are taken to curb the leak. If promptly recognized, the trouble might be overcome by simple changes.

(c) A periodic, usually monthly, estimate of total probable cost. This is a report on the status of the entire job. Care should be exercised to include every item of cost incurred and to be incurred. The estimate of total cost is composed of all expenditures to date and the estimate of cost to complete.

(d) Final report. The final report serves as a history of the work and is valuable for reference purposes when preparing bids in the future. The final report should include a record of the first cost of plant, brief description of construction operations, unusual difficulties and con-

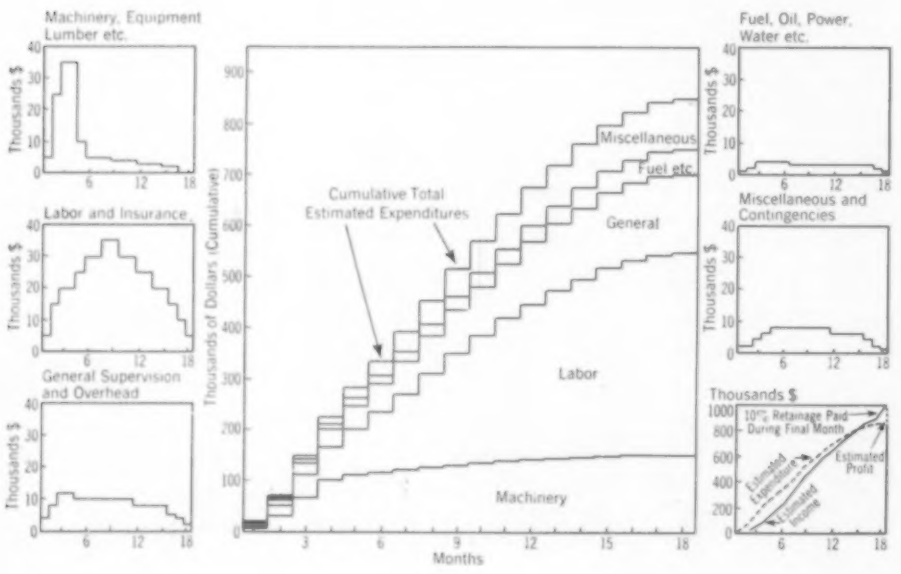


FIG. 3. CHART OF ESTIMATED EXPENDITURES tells management how much money is needed to begin and carry on job. Total cost estimate, when plotted against estimated income (chart at lower right), indicates to owner and banker when earnings can be expected to equal or exceed expenditures. This chart is based on Fig. 12 in *Construction Planning and Plant*, Adolph J. Ackerman and Charles H. Locher, McGraw Hill Book Co., Inc., 1940, p. 50.

struction methods, record of wage scales, major material prices and photographs, etc. This report should also include a record of the method followed in allocating non-direct costs.

One of the most effective ways of presenting cost data, especially that covering continuing operations, is by means of graphs and charts. There is perhaps no clearer way to show a trend than by the use of curves.

Cost Engineer Has Wide Field

The efforts of the cost engineer ultimately focus on one major goal—to supply records of such simplicity and accuracy, and so intelligently presented, as to give full and perfect control over all costs. If this goal is achieved it is certain that all other requirements, such as budget reports, final reference and estimating records, reports for the home office, etc., will be fulfilled. The work and interest of an experienced cost engineer transcends mere job cost control if he is to develop to full stature and if he aspires to advance his art. There is no limit to his field. Many top-notch cost men are engaged in preparing statistics for construction business reports and cost indices such as those published by the *Engineering News-Record*, Turner, Fruin-Colnon and Austin. Also, as another example of the fact that cost-minded men are alert to the widespread interest in costs, in the July 8 issue of *Engineering News-Record* there is an editorial entitled "Cutting Road-building Costs." In the same issue are articles on "Three Cost-Cutting Tips from Texas," "More Mechanization Is Best Bet for Cutting Construction Costs," and others—all on cost cutting.

COST ANALYSES AND COST STUDIES must be started as soon as possible after job gets going. Post-mortems when work nears completion do little good except to correct errors and cut costs on future work. Photo shows large steel sheetpiling job for Locks 27, Chain of Rocks Project, Upper Mississippi River, where cofferdam piling is being driven to rock.

The successful cost engineer or the successful contractor not only analyzes his own costs so as to obtain full control of his own work, but also studies cost statistics and methods published by others to learn what they are doing and, more important perhaps, to keep abreast of the trend. For it is impossible to think of construction and not think of costs.

One more factor which has an important bearing on cost control should be mentioned. If the bid items of both public and private clients can be made to include provision for construction plant, including equipment, camp and temporary buildings, an important step will have been taken towards accomplishing standardization in cost systems. Equally important results of such a practice would be the savings resulting from simplification in estimating and an

(*Continued on page 73*)

FIG. 4. **PROGRESS SCHEDULE CHART** for pile driving and pier job illustrates method of checking actual progress against anticipated progress. Review of chart such as this during progress of work, together with cost analyses, acts as guide to planning engineers and job superintendent in scheduling remainder of job.

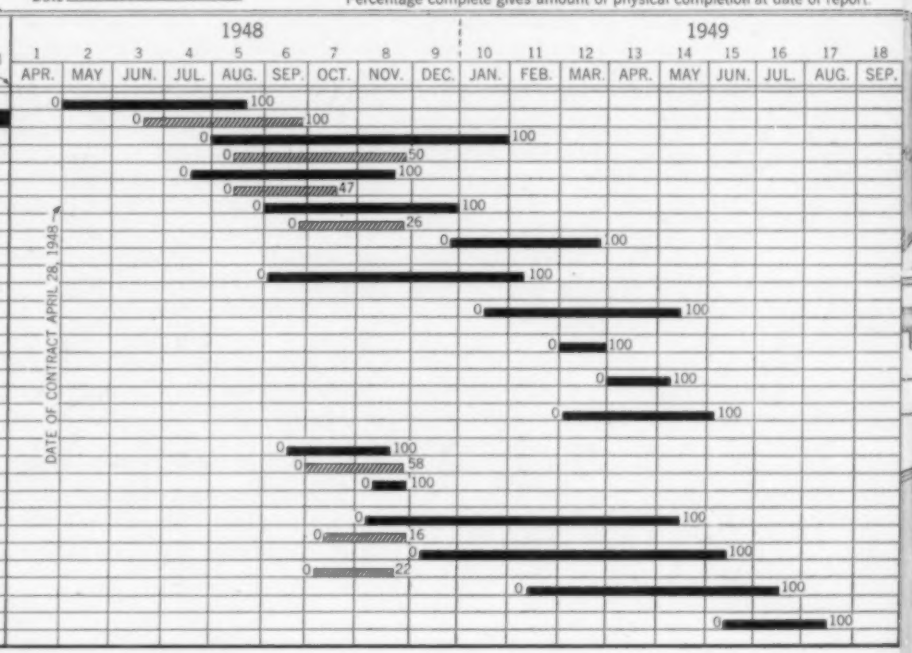
PROGRESS SCHEDULE

Job No. _____
Project _____

Report No. 14
Date NOV. 27, 1948

CODE: Upper half of space shows estimated quantities and progress.
Lower half of space shows actual quantities and progress to date.
Vertical line indicates date of progress schedule report.
Percentage complete gives amount of physical completion at date of report.

ITEM	QUANTITY	UNIT	START	FINISH	PERCENT PHYSICAL COMPLETION 0 100
SET UP CASTING YARD	COMPLETE	—	4-28-48	8-21-48	
	COMPLETE	—	6-20-48	9-25-48	
CAST PILES	1,570	PCS.	8-2-48	1-29-49	
	788	PCS.	8-15-48		50
DRIVE WOOD PILES	1,178	PCS.	7-19-48	11-20-48	
	560	PCS.	8-15-48		47
DRIVE CONC. SHT. PILES	1,000	PCS.	9-1-48	12-24-48	
	264	PCS.	9-24-48		26
DRIVE PIER PILES	570	PCS.	12-27-48	3-26-49	
		PCS.			
CONC. WALL & ANCHOR	2,124	C.Y.	9-2-48	2-12-49	
	85	C.Y.			
PIER DECK CONCRETE	3,150	C.Y.	1-17-49	5-14-49	
		C.Y.			
DRIVE FENDER PILES	190	PCS.	3-1-49	3-31-49	
		PCS.			
CONSTRUCT FENDER SYSTEM	COMPLETE	—	4-1-49	5-6-49	
	COMPLETE	—			
WAREHOUSE	COMPLETE	—	4-4-49	6-4-49	
	COMPLETE	—			
DREDGING - EARTH	400,000	M³	9-20-48	11-18-48	
	230,000	M³	9-30-48		58
- ROCK	18,800	M³	11-13-48	11-27-48	
		M³	10-26-48		
FILL - BULKHEADS	30,581	M³	11-8-48	5-14-49	
	4902	M³	10-11-48		16
CULVERTS	9	UNITS	12-6-48	6-11-49	
	2	UNITS	10-6-48		22
PAVING	14,250	M²	2-14-49	7-16-49	
		M²			
MOVE OFF	COMPLETE	—	6-13-49	8-13-49	
	COMPLETE	—			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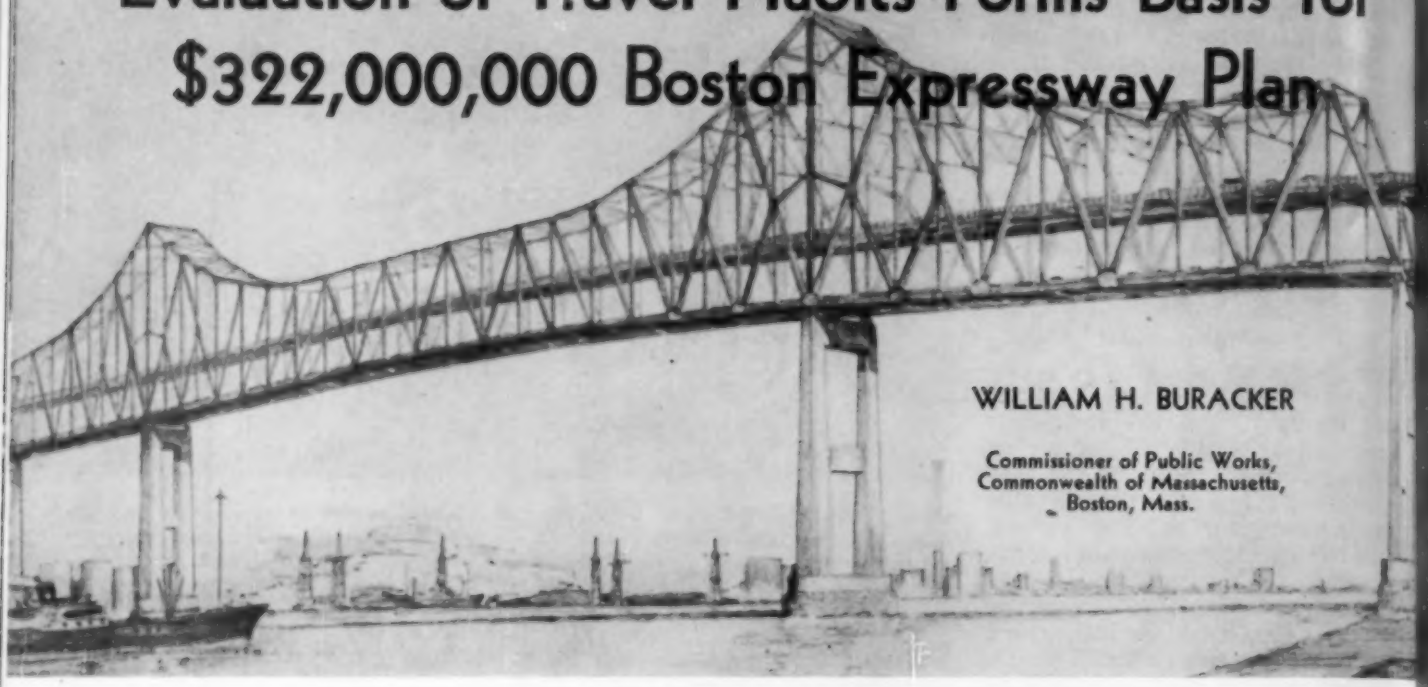
Evaluation of Travel Habits Forms Basis for $322,000,000 Boston Expressway Plan



WILLIAM H. BURACKER

Commissioner of Public Works, Commonwealth of Massachusetts, Boston, Mass.

MYSTIC RIVER BRIDGE—unit in Boston Expressway Plan—connects Charlestown (Boston) and Chelsea, Mass., on route of Northeast Expressway. Double-deck toll structure, now under construction at cost of $27,000,000, has center span 800 ft long and 135 ft above high water.

EIGHTY-SEVEN MILES of limited-access routes make up the highway system planned for the Boston metropolitan area, to be arranged like the spokes of a wheel radiating from an inner belt route encircling the downtown area. Studies under way for many years culminated in the appointment of a Joint Board in August 1947 to study Boston's serious traffic congestion problem and coordinate previous work in the field. Aided by three private engineering firms—Charles A. Maguire and Associates of Boston, in cooperation with DeLeuw, Cather & Co. of Chicago, and J. E. Greiner of Baltimore—the Joint Board submitted a final report to the Governor of Massachusetts in February 1948. Construction has been started on several basic parts of the plan but as yet the state legislature has not approved the bond issue required to carry the plan as a whole past the preliminary stage.

TRAFFIC PROBLEMS of Metropolitan Boston, like those of all other large urban areas, have been the subject of considerable study for many years. But not until 1947 were there available basic traffic data for the entire area of sufficient accuracy and reliability to make it possible to proceed with the preparation of a real master highway plan. By the middle of 1947 the Massachusetts Department of Public Works had made sufficient progress on its origin and destination survey to permit a start on the master plan study.

On August 9, 1947, Governor Robert F. Bradford directed that a Joint Board consisting of the executive heads of the Department of Public Works, State Planning Board and Metropolitan District Commission be organized to prepare a master plan and report its findings in time for consideration by the 1948 session of the General Court.

It soon became apparent to the Joint Board that such an undertaking could not be completed within the specified time with existing personnel unless other essential activities were curtailed or postponed. It was therefore decided to engage the services of an engineering firm of national reputation to assist the Joint Board, act as its consultants and furnish technical personnel. The firm of Charles A. Maguire and Associates of Boston was selected in cooperation with DeLeuw, Cather & Co. of Chicago and J. E. Greiner Co. of Baltimore. A technical committee of engineers from the participating state agencies and the Public Roads Administration has also assisted the Joint Board. Federal funds have participated in paying the cost of the work. The final report embodying the master plan was submitted to the Governor on February 13, 1948.

Origin and Destination Study

The origin and destination survey which produced the basic traffic data was conducted by the Traffic Division of the State Department of Public Works in cooperation with the Public Roads Administration. The area covered included 23 cities and towns in addition to Boston, a total area of 380 sq miles with an estimated population of 1,810,000. As a result of 22,000 house-to-house calls on a 5 percent sample basis and 130,000 roadside interviews, data were produced showing origins and destinations of 810,000 daily trips through and within the area. To obtain complete information on traffic movements, each city and town within the study area was divided into zones and further subdivided into sectors, the latter consisting of two or three city blocks. The area was thus subdivided and coded into 138 zones and 648 sectors of which 17 zones containing 177 sectors are in downtown Boston.

From these data it was possible to plot "desire lines of travel." A desire line of travel can be defined as a straight line between a point of origin and a point of destination for a trip or group of trips without regard to the actual routes traveled via existing streets. In other words, a desire line is the line of travel which would result were there a straight-line highway in existence between the point of origin

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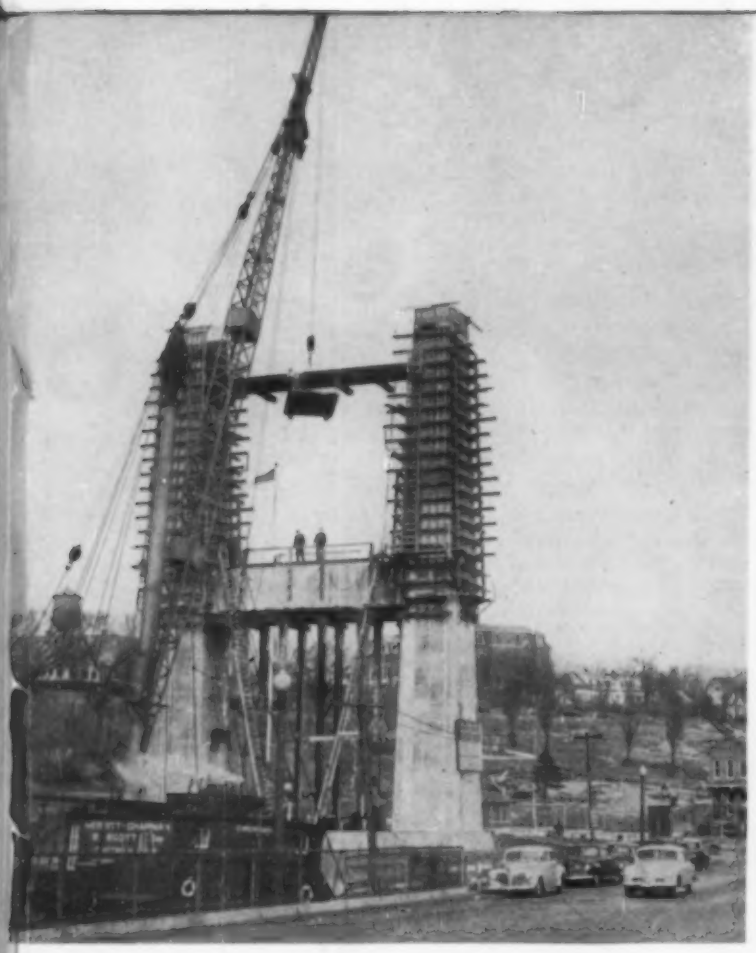


BOOM 135 ft long, with 25-ft extension, places forms for top of bridge pier in Mystic River near north bank and adjacent to Chelsea Naval Hospital. Merritt-Chapman & Scott's floating derrick Cincinnati carries boom and 90-ft tapered steel mast with bottom diameter of 30 in.

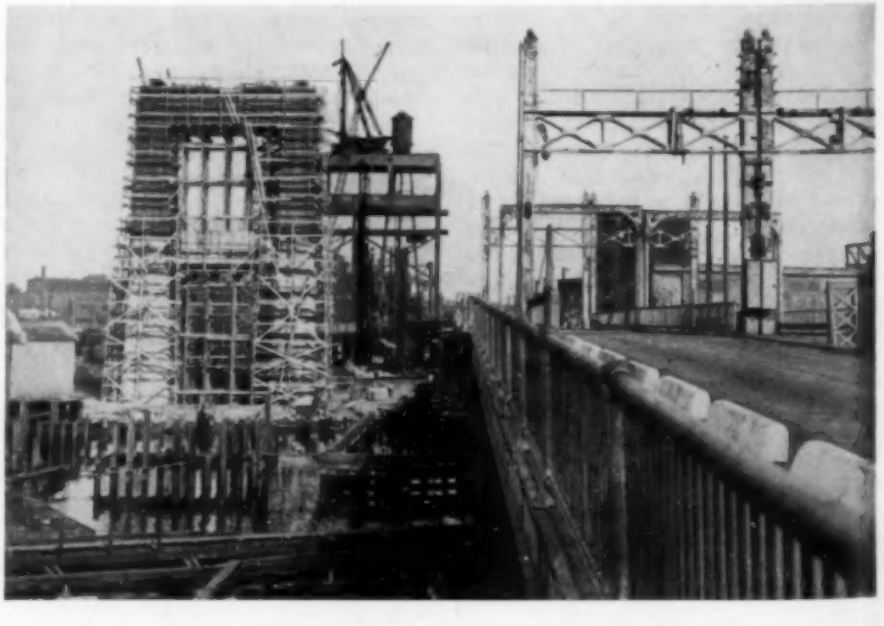
elevations of existing highways and railroads crossed by the expressways. However, where possible, the fifty-fifty principle will be applied whereby the expressway grade is raised or lowered one-half of the vertical separation distance and the intersecting highway the remaining distance. In this manner deep cuts and high fills are minimized. A maximum grade of 3 per cent has been established as one of the governing conditions. In several urban districts the physical restrictions are such as to require the use of depressed sections confined between retaining walls. On certain other sections, including the Central Artery portion of the belt route, an elevated highway design must be utilized. Where necessary, parallel service streets will be included to serve adjacent properties locally. Ramp connections will be provided for ingress and egress at important intersecting highways.

Improvements to existing streets and highways will be necessary to supplement the major expressway system in order that efficient collection and distribution of traffic to and from the expressways may be effected. These proposed improvements vary in magnitude from major street widenings and grade separations to rearrangement of one-way streets, channelization of traffic and installation of traffic lights.

Radial Routes Described

The various routes are shown by heavy black lines on the map, Fig. 1. Starting at the southeast section and proceeding clockwise around the map, the so-called Southeast Expressway will parallel the Old Colony Parkway, bypass Quincy and connect with Routes 3 and 18 in Weymouth. To the southwest it was found advisable to provide one route lying halfway between Hyde Park and Dedham with a connection to the existing Neponset River Parkway. The southern terminus of this expressway will join U.S. Route 1 in Westwood. The desire lines to the west showed the greatest volumes of traffic. It was considered inadvisable to attempt to bring the existing Worcester Turnpike (Route 9) in this area up to limited-access standards because of steep grades and right-of-way difficulties. The turnpike will, however, be improved as an important adjunct to the expressway system. The proposed Western Expressway will parallel the Charles River, pass through Watertown and Waltham and connect with Route 30 and U.S. Route 20.

Traffic from the northwest now follows the Concord Turnpike and the Alewife Brook Parkway in approaching Boston. This traffic, added to that from the Winchester-Woburn area, is sufficient to require the so-called Northwest Expressway through Cambridge and Somerville to connect with the Belt Route. This expressway will also connect to a future extension of U.S. Route 3 to Lowell. The existing Northern Artery through Somerville carries the heaviest concentration of traffic in the entire metropolitan area and should be brought up to expressway standards as far north as the Revere Beach Parkway. From that point a new expressway is proposed through Malden, Melrose, Stoneham, Wakefield and Reading to connect with Route 28. Because this northern route is expected to carry the largest volume of traffic in the network it is proposed that it enter downtown Boston without connection to the Belt Route, an arrangement which is expected to



IN TOTAL LENGTH of more than two miles, Mystic River Bridge spans both Little Mystic Channel and Mystic River proper (see map, Fig. 1). View at right shows construction of reinforced concrete piers in Little Mystic Channel between present span, at right, and Boston and Maine freight yards, at left. Pier designed to carry toll plaza and administration offices appears in background.

facilitate traffic distribution in the downtown area.

Two major desire lines extend to the northeast—one through Everett, Malden and Saugus, the other through Chelsea, Revere and Lynn. A location for one expressway lying between these two lines was decided upon which coincides exactly with the location of the new Mystic River Bridge now under construction. This proposed Northeast Expressway will, in conjunction with the new bridge, provide a facility connecting Routes U.S. 1, the Newburyport Turnpike, Route 107 and Route 1A to the downtown area and via the belt to all other points in the metropolitan area.

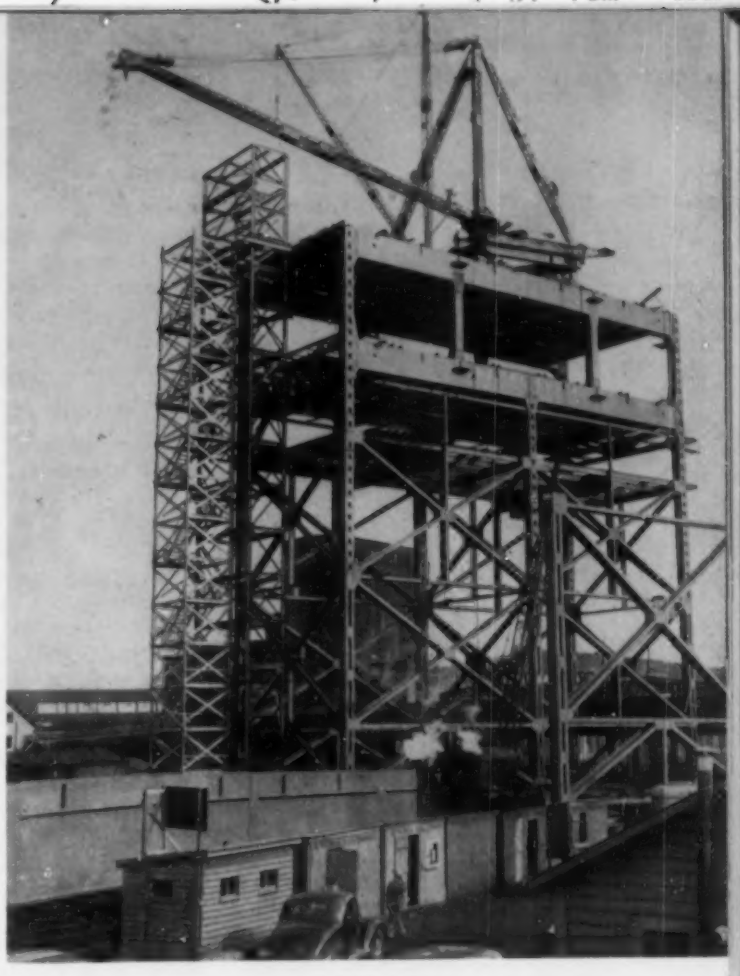
Two other major desire lines terminate in the East Boston-Revere area. This traffic is presently served by the two-lane Sumner Tunnel which connects with the Logan Airport and Routes C-1 and 1A to the northeast. The proposed East Boston elevated highway and the expansion of the airport will increase the traffic demands on the tunnel. Therefore the long-sought second tube of the tunnel is recommended as a part of the expressway system. The two tunnels will operate as a pair of one-way arteries between the Belt, downtown Boston and East Boston.

The traffic analysis shows the need for an additional facility along the southerly side of the Charles River Basin. The construction of the proposed Embankment Road Extension will greatly relieve the overburdened streets of the Back Bay section of Boston.

Belt Route for Downtown Area

To provide a by-pass for traffic around the downtown area and to facilitate the distribution of traffic from the radial expressways to the major streets, the so-called Belt Expressway has been proposed. To operate efficiently, however, the Belt will have to be supplemented by an adequate system of improved and widened one- and two-way streets in downtown Boston.

The Belt begins at a point near City Square, Charlestown, where a connection to the new Mystic River Bridge is proposed; passes south over the Charles River; thence, via an elevated highway, connects with the Sumner Tunnel; passes by the South Station; parallels Albany Street and joins with the Southeast and Southwest Expressways in the vicinity of Massachusetts Avenue and Southampton Street. From that point it extends to the west through Roxbury to connect with the Worcester Turnpike at Brookline Avenue, thence to the northwest across the Charles River just west of the Cottage Farm Bridge to connect with the Western Expressway in Cambridge. Thereafter it extends north through Cambridge to connect to the Northwest Expressway, turns east to cross the Northern Artery, passes over the Boston and Maine Railroad yards, and joins the Northeast Expressway at the Mystic River Bridge.



DERRICK PLACES STEEL ON PIER designed to carry both toll plaza (on top) and administration offices of bridge authority (on level below derrick). Pier, which is located in freight yards of Boston and Maine Railroad, Charlestown, is one of 60 piers now under construction (out of total of 83) for Mystic River Bridge.

An adequate number of ramps is provided at intervals along this facility so located that in no case will surface streets be congested by the discharge from the ramps. The Belt route is somewhat larger than has been found necessary in other cities where comparable studies have been made. However, in Boston an unusual number of radial routes are involved, extensive areas of water are encompassed, and several distinct business centers rather than the usual one are served. Traffic volumes on this belt are very high. A six-lane facility is required to handle movements which are expected to vary from 40,000 to 80,000 vehicles daily by 1970. To handle this volume an extra lane is considered necessary in some instances to serve the acceleration and deceleration movement.

From the map, Fig. 1, it can be easily seen how well the proposed plan serves the entire area for the major flow of heavy trunk movements in all directions. Truck traffic will particularly appreciate the new expressway system since such traffic has been seriously impeded in this area by the lack of direct through routes of adequate capacity.

The consultants' report to the Joint Board presents estimates of costs which include construction at current prices and land damages at assessed values. The total cost of the Master Highway Plan, including improvements to existing streets, is estimated to be $322,000,000. A program of stage construction, based on priority of need and indicating costs by construction periods, is also included. The arrangement is flexible, however, and may be varied from time to time to suit changing traffic demands or fluctuating financial conditions. Considering the magnitude of the plan as proposed it is not surprising that the cost estimates reach into many millions of dollars.

The highway problems of the commonwealth are not confined to the Boston metropolitan area. Throughout the remainder of the state there are many points of acute traffic congestion, many miles of inadequate highways, many bridges of insufficient width and strength. These problems are recognized in the current report of the Department of Public Works on state highway needs. To correct these conditions, many additional millions of dollars will be needed.

In attempting to produce a financing program for the metropolitan plan, the needs of the remainder of the state must be kept in mind, and a fair balance maintained in order that an equitable expenditure of high-

way funds may result. Current gasoline tax incomes will undoubtedly prove inadequate to provide for underwriting the program on a pay-as-you-go basis. On the other hand, attempting to scale construction progress down to meet the tempo of normal highway fund income would prolong completion of the plan too far into the future. Means should be found to provide for an accelerated ten-year construction program, and at the same time keep gasoline tax levies within reasonable bounds.

Methods of Financing

The Joint Board, being firmly of the opinoin that speed of accomplishment is the very essence of the proposed metropolitan highway plan, urged that every reasonable step be taken to bring about its effectuation within the prescribed ten-year period. As previously pointed out, construction cannot be accomplished under any pay-as-you-go policy, based on present highway funds. While it is essential that the expressway system be completed in the shortest time possible, it should be remembered that the system is designed to care for major highway needs for years in the future. It is only reasonable to expect that the future users of the system should share in its cost.

It was recommended that beyond the amounts which may be appropriated from current revenues, the remainder of the costs be financed by long-term bond issues, using part of the proceeds of the highway fund for amortization. The projects proposed in the master plan for the Boston area represent a total cost approximately equal to that of the Department of Public Works program for the remainder of the state. It therefore seems reasonable to expect that a proportionate share of future funds available for new construction should be allocated toward the financing of the metropolitan plan.

The entire financing program could undoubtedly be greatly accelerated by the collection of tolls from users of the expressway system. The consultants' report points out the savings in time and money inherent in the use of modern superhighways. The proposed expressways will afford their users such savings in time and such comfortable and pleasant travel conditions that it is doubtful if there would be any substantial opposition to the imposition of small tolls. The collection of nominal tolls would serve to speed up the construction program and hasten the retirement of the bonds. Inasmuch as a decision to recommend a specific system of tolls would have to be based on an exhaustive scientific study involving many complicated factors, the Joint Board was unable to make definite recommendations at the time of the report. It was urged, however, that a toll system be immediately made the subject of a study.

Provision for Tenant Relocation

A serious impediment to all major highway development in recent years, one which may well continue for some time, has been caused by the housing situation. Although every possible attempt is always made in laying out highways to avoid the taking of residential property, it is impossible to locate new arterial routes in urban areas without affecting some homes. The natural reluctance on the part of highway officials to force people to vacate their homes in these times of housing shortages, while understandable, has nevertheless resulted in the postponement of essential highway projects. On the other hand, the vigorous opposition of persons whose homes are involved is also easily understandable Arguments that the few must suffer for the benefit of the many fail to impress the man who is told he will have to vacate his home to make way for a projected highway. In this day and age a more sympathetic approach to the problem is needed.

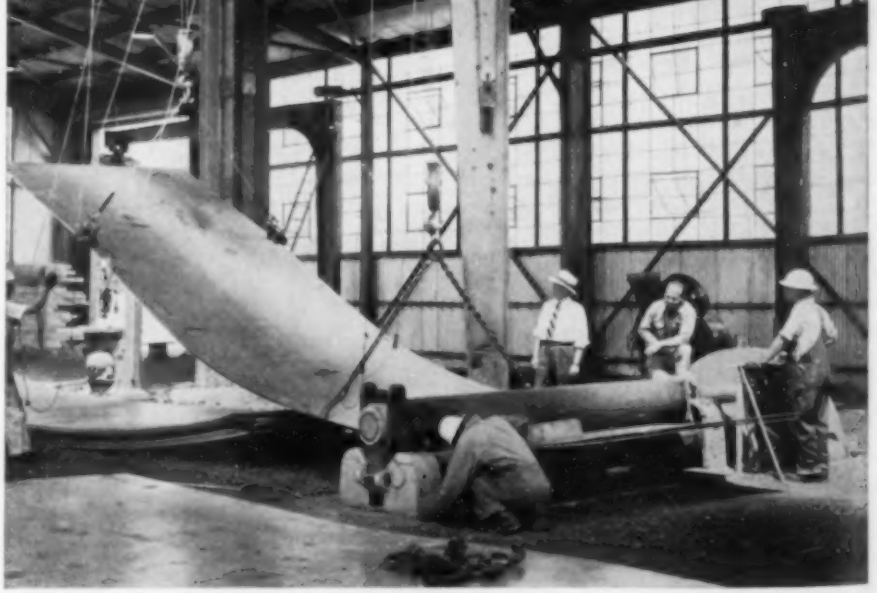
It should now be recognized that the relocation of tenants is an integral part of the highway project. If homes must be taken to clear the right-of-way, advance provision should be made to relocate the occupants in new living quarters at least as good as those they are required to leave. Admittedly not easy of accomplishment under present housing conditions, the solution should be attempted in a realistic manner, as is being done in other cities such as New York, Chicago, and Los Angeles. When the structural condition of buildings permits, they should be moved to nearby vacant land.

To assist tenants there should be set up an office of tenant relocation in conjunction with each major highway project. In congested areas, particularly those characterized by substandard housing, consideration should be given to mass relocation of tenants in new housing projects. Sincere efforts along the lines suggested should go a long way toward facilitating the acquisition of rights-of-way and making possible an early start on actual construction.

Policy of Development Control

Since completion of the entire program will require at least ten years, it can readily be seen that in the meantime normal use and development of

(*Continued on page 72*)



NEW STEEL FABRICATING PLANT of Chicago Bridge & Iron Co., equipped to fabricate flat-bottom tanks, floating roofs, reservoirs, etc., rolls first plate in recently completed Salt Lake City Shop No. 1. Shop No. 2, of similar construction, scheduled for completion in spring of 1949, will supplement Shop No. 1 in providing fully integrated plant with facilities for fabricating company's line of Hortonspheres and spheroids, Hemispheroids, Waterspheres, Vaporspheres, elevated tanks and similar structures.

SAN FRANCISCO–OAKLAND BAY BRIDGE, here seen during construction period, was opened to traffic in November 1936, but already is operating close to its ultimate capacity. San Francisco Toll Crossing Division recommends immediate construction of duplicate bridge 325 ft to north of present structure (to left in this view).

Parallel Bridge Recommended for San Francisco Bay Crossing

AT AN ESTIMATED COST of $155,000,000, Ralph Tudor, M. ASCE, chief engineer of the San Francisco Bay Toll Crossings Division of the Department of Public Works of California, recommends the immediate construction of a parallel bridge crossing San Francisco Bay, 325 ft to the north of the present San Francisco–Oakland Bay Bridge. The recommendation was part of a complete report submitted in November 1948 to C. H. Purcell, Hon. M. ASCE, Director of Public Works of California. The California Toll Bridge Authority is expected to decide on the recommendation after holding public hearings. A comprehensive paper, presented before the Structural Division at the Seattle (Summer) Convention by Mr. Tudor, was briefed in CIVIL ENGINEERING, August 1948, page 38.

After a year of study of both routes by a staff of engineers and consultants, Mr. Tudor reported that but one crossing can be financed at this time. The report compares costs, benefits to traffic, methods and amount of financing, and periods of construction for each crossing. It concludes that the southern crossing will not effectively relieve traffic on the present bridge, traffic studies having shown that only a fifth of the present and future trans-bay traffic would be served best by the southern crossing.

A Joint Army-Navy Board authorized by Congress in 1946 investigated all locations and types of trans-bay crossings including the "system of dams across San Francisco Bay as provided in the so-called Reber Plan," and recommended the southern crossing then estimated to cost $134,000,000.

Motor traffic on the present bridge, which provides six lanes for automobile traffic on its upper deck, and, on the lower deck, two lanes for trucks and buses and two tracks for electric trains, is growing so fast that by 1953 the capacity of the structure will be reached. Tolls are 25 cents per car.

The two routes considered in the report are shown in Fig. 1. Table I lists the factors which influenced the decision in favor of building the parallel bridge first. The report states that raising tolls from 25 to 35 cents at once would assure financing by 1950 so that the parallel bridge could

(*Continued on page 72*)

TABLE I. COMPARISON OF SAN FRANCISCO BAY CROSSINGS

Based on Consistent Estimates

Factors	Build Parallel Bridge First	Build Southern Crossing First
Total constr. cost	$155,014,000	$178,421,000
Recommended toll	25 cents	35 cents
Earliest date for financing	March 1950	March 1951
Annual operation & maintenance	$1,770,000	$2,210,000
Construction period	4 years	5½ years
Open for traffic	March 1954	Sept. 1956
Relief of street congestion at approaches	No choice	No choice
Percent of transbay traffic best served	82%	18%
National defense	.....	Slight favorable margin
Date when congestion will be relieved on present bridge	March 1954	Never

FIG. 1. MAP SHOWS LOCATION of alternate crossings of San Francisco Bay.

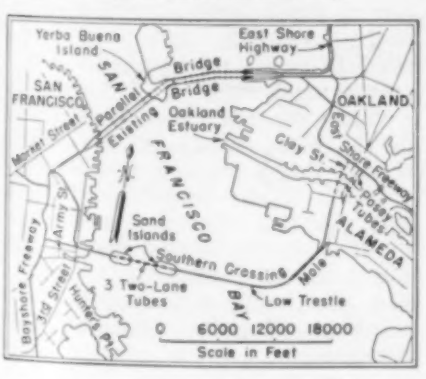
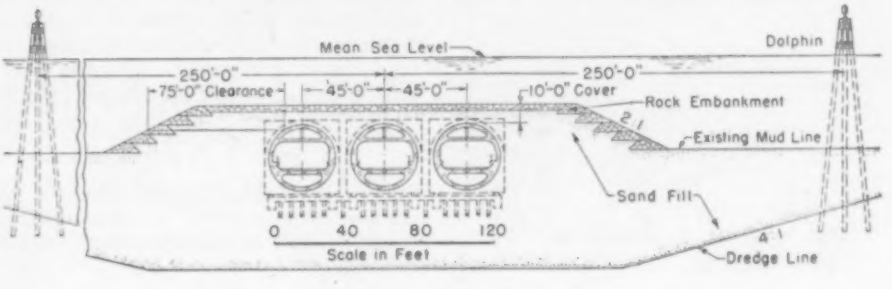
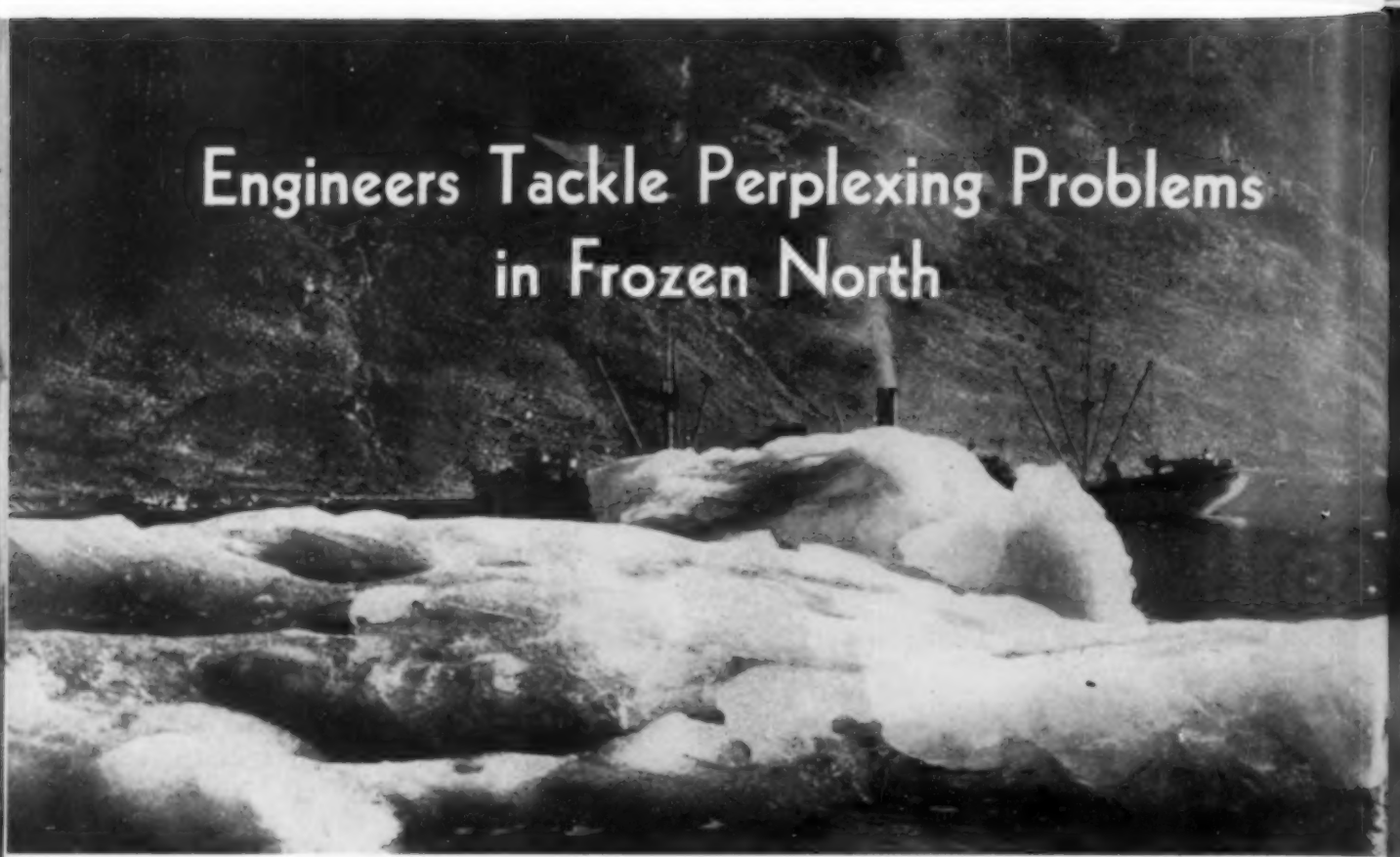


FIG. 2. SUBAQUEOUS PORTION of southern crossing presents more difficult engineering problems than bridge. Report favors parallel bridge identical to present San Francisco–Oakland Bay Bridge. Construction of southern crossing—low-level trestle and causeway combination designed to dip under navigable channels in three two-lane subaqueous tubes—would be deferred until tolls from two bridges can finance its construction.



Engineers Tackle Perplexing Problems in Frozen North



SUMMER IN EAST GREENLAND does not mean absence of icebergs. Low temperatures in arctic and subarctic regions reduce efficiency of personnel and affect accuracy of all field work.

INCREASED MILITARY activity in the arctic regions has focused attention on the engineering problems encountered there. In constructing military posts, and establishing lines of communications in remote arctic areas, climatic conditions become a major factor in the efficiency of operation. North of the Alaskan Range in the vicinity of Fairbanks, conditions are most severe. In winter there are only brief periods of daylight and temperatures drop as low as minus 70 deg F each year. Here equipment must be redesigned to prevent freezing, and personnel find living conditions almost unbearable. Extensive areas of permanently frozen ground (permafrost) create footing problems. Heat escaping from a building gradually melts the ground surface, changing its bearing capacity, causing settlement and frequently failure. Utilities placed on the ground must be heated to prevent freezing. Since 1940, both Mr. Spofford and Mr. Hyland have been directing the design, construction, and supervision of projects in the arctic and subarctic. Mr. Spofford describes the field conditions and design requirements, and Mr. Hyland and Mr. Mellish discuss the economy of utilidors. The papers here presented were originally delivered before the Structural and Sanitary Engineering Divisions respectively at the ASCE Boston Meeting.

Low Temperatures in Inaccessible Arctic Inflate Construction Costs

C. M. SPOFFORD, M. ASCE

Fay, Spofford & Thorndike,
Boston, Mass.

THE MOST SERIOUS PROBLEMS confronting field engineers in arctic regions are transportation, shelter, food, and protection against frost and insects. One of these difficulties—transportation—has been relieved by the use of chartered airplanes.

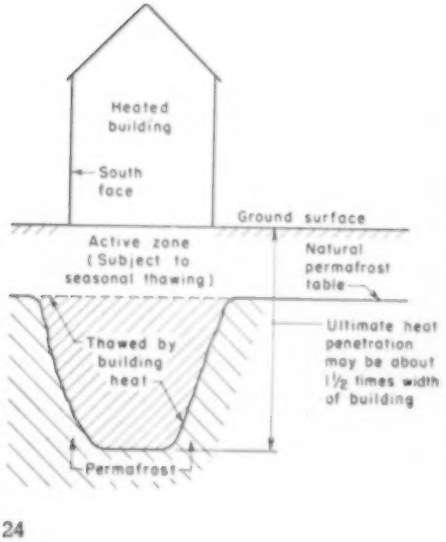


FIG. 1. DIAGRAM SHOWS effect of building heat on permafrost. If soil is unstable, condition such as this can cause failure of structure.

There are numerous peculiarities common to engineering field work in the Far North. In extreme northern latitudes, that is, above 55 deg, any control survey run during the summer months must be done at night. Heat waves are of such intensity that refraction causes serious errors. It is preferable to run such control surveys during the darkest portion of the night and to use artificial lights if necessary. For the determination of true azimuth in extreme northern latitudes, observations on the sun are more

PERMAFROST ENCOUNTERED in excavation work in Alaska often takes form of mounds (right), which are hard as rock and yet may become unstable upon thawing.

accurate than polaris observations which prove inaccurate or impossible because of the large vertical angle.

A vast expanse of frozen swamps runs throughout the North, termed tundra in Alaska, muskeg in Central and Western Canada, and bog in Newfoundland and Labrador. Surveying in this terrain is difficult owing to the instability of instrument sites in the summer and, in the winter, because of the problem of establishing permanent reference points. Temperature corrections in chaining are of particular importance as temperatures in the Far North, particularly in the Tanana Valley in Alaska, range from 100 deg above, to 75 deg below, zero deg F.

Clothing worn during the summer months does not differ greatly from that worn in the United States. However, insect repellent must be used until the first frost in September, as protection against droves of mosquitoes and black flies. During the winter the clothing worn should be similar to that of the Eskimos.

Frigid Winds Reduce Survey Accuracy

In the Aleutian Chain, south of Alaska, the temperature rarely goes down to zero in the winter or above 50 deg F in the summer. However, high winds up to 150 mph carrying horizontal rain and snow are prevalent throughout the area, making survey work extremely difficult during all seasons. The amount of daylight in the Chain is comparable to that in Maine and Minnesota.

Southeastern Alaska, commonly known as the Panhandle, has temperatures ranging from around zero in the winter to the middle 70's in the summer. This region is subject to intense rainfall during the summer months and heavy snow during the winter. In the area adjacent to Whittier, high winds accompany rain and snow to make field work extremely difficult.

In the Anchorage area of Alaska, which is south of the Alaskan Range, precipitation is low and the average wind velocity is approximately 4 mph. Engineering may be carried on throughout the year with little inconvenience as summer temperatures range from about 80 deg to average winter temperatures of about 10 deg below zero.

North of the Alaskan Range in the Fairbanks area, at Nome and Point Barrow, most severe conditions are encountered. All during the summer, daylight extends around the clock and during the winter the daylight hours range from 10:30 a.m. to 2:00 p.m. in the Fairbanks area to nothing but twilight in the Point Barrow area. Moreover, temperatures drop to 70 deg below zero in the wintertime and have been known to go as low as minus 84 deg adjacent to the Yukon territory boundary. During the winter of 1946–1947, which was the coldest on record, a railroad survey was run between Fairbanks and Mile 26 on the Alcan Highway at temperatures approaching minus 45 deg for a large portion of the time. Many errors were found in the work. Surveys should not be attempted when temperatures fall below minus 20. It is necessary for survey parties working in sub-zero temperatures to be furnished with a mobile skid shack equipped with a stove for personnel who are not engaged in physical exercise, especially transit men and note-keepers. During these periods of extremely low temperature wind velocities are practically zero and an ice fog surrounds human bodies.

CORDUROY for new railroad (above) is placed over thick blanket of moss. Both corduroy and moss act as insulation in preventing permafrost from thawing. Railroad bed will be placed on top of corduroy.

The working conditions and hours throughout Northern Canada, Newfoundland, Labrador, and Greenland do not vary appreciably from those found in Alaska. High winter winds contribute to physical discomfort and cause inaccuracy due to difficulty in the proper manipulation of instruments and equipment.

Costs of performing survey work in the North during the summer months compare favorably with costs in the United States except for the extra transportation and salary costs applicable to the arctic area. However, during the winter the costs increase appreciably, and run approximately four times higher than those for normal surveys in the States.

Throughout the North there is an almost complete lack of horizontal or vertical control. Where the U.S. Geological Survey, the U.S. Coast and Geodetic Survey, or the Canadian Geodetic Survey has not placed permanent monuments, horizontal control can be established only by observation on the sun, and vertical con-

WINTER CLOTHING of engineer in arctic is similar to that worn by Eskimos.

trol by precise aneroid barometers. When an attempt is made to tie two locations together where horizontal and vertical controls have been established by independent agencies, it is usually found that errors exist which must be reconciled.

If and when the various governmental agencies finally establish control, it will then be necessary to adjust surveys to meet the authenticated system. In Alaska, the U.S. Geological Surveys which were run in the early part of the century were monumented largely along the various streams. Since that time, erosion has demolished a large portion of the monuments which were ultimately to be used as control for the entire grid system.

Foundations on Permafrost

Permanently frozen ground, called permafrost, is usually found wherever the mean annual temperature is below the freezing point. Permafrost covers approximately one-fifth of the world's land area. It is found in more than three-quarters of the area of Alaska, about one-half of Canada, and a large part of Siberia. The layers of frozen ground vary in thickness. They are continuous in extremely cold areas, but are discontinuous in borderline regions near the southerly limits of the permafrost zone.

The existence of permafrost poses problems for the engineer which are entirely different from those encountered in temperate zones, and new and radical solutions must be found. For example, in temperate zones where seasonal freezing may be expected, the engineer places his building footings below the depth of seasonal frost penetration, but in the permafrost zone that simple expedient is not possible, the thickness of the frozen layer being as much as 1,500 ft in some areas. Research on the subject by the Corps of Engineers is being conducted by the St. Paul District at its field station near Fairbanks, Alaska.

What usually happens under a heated building constructed on permafrost is shown in Fig. 1. The heat from the structure is transmitted gradually into the soil, and after a period of years a bowl-shaped pocket of thawed material forms under the building and for a short distance around it. If the soils in the permafrost zone are stable granular materials, no serious settlement will occur; however, in many cases the permafrost contains fine-grained soils with a high moisture content and upon thawing the moisture is released, sharply reducing the bearing value.

Many building failures have occurred on this account. At a base on Baffin Island, a machine foundation of a temporary diesel power plant settled so seriously that it was thought that the plant would have to be abandoned. It was essential, however, that the plant be kept in operation until a permanent plant under construction was ready. Refrigerant was circulated in pipe coils in trenches alongside the machine foundations until the ground was refrozen and the settlement arrested. At another base, in Greenland, a similar settlement was arrested by inserting long timber beams under the structure and the machine foundations, with the ends of the timbers resting on unthawed permafrost outside the building area.

However, no really satisfactory solution has been arrived at for the construction of heavy permanent buildings on a great depth of fine-grained permafrost soil. If possible permanent buildings in permafrost areas should be located on soils which are sufficiently stable so that thawing does not have an adverse effect.

In the case of an extensive development, however, it may not always be possible to pick and choose locations. It may become necessary to place buildings over unsatisfactory permafrost. It will be imperative, in such cases, to make definite provision for preventing the flow of heat from the building into the ground. The simplest way of doing this is to abandon the idea of having a warm basement and to erect the building on posts with positive circulation of cold air under the building. The posts, of course, would have to be anchored in permafrost at such depth that thawing can never penetrate to the bottom of them.

Space Heating and Fuel Costs

Space heating in arctic and subarctic regions should be closely based on usual calculations of heat loss bearing in mind the very short daylight hours, low solar angle, and low average temperatures. With the high cost of fuel, building insulation is of prime importance. In using panel or radiant heating, great care must be exercised with ground floors in the presence of permafrost for the reasons previously mentioned.

Powerplant locations should follow customary practice of having a sufficient supply of boiler feed and condenser circulating water, together with careful consideration given to escaping vapors and fly ash that might combine with ice fog to set up a hazardous and undesirable pall which is not quickly dissipated by the low-velocity winds that prevail during sub-zero temperatures.

The following cost factors for Alaskan localities have been accepted by the Office of the Chief of Engineers. This index is based on United States costs furnished by the District Engineer for contractors bidding on Alaskan work. These prices were valid in May 1948 and have increased since then.

Location	New Index
Adak	2.5
Fort Richardson, Whittier	2.5
Ladd, Mile 33, Mile 26, Naknek	3.0
Able	3.0
Nome	3.0
Ft. Yukon, McGrath, Galena	4.0

Sanitary Engineering

Sanitary engineering in the North embraces the same field as in temperate climates except that the occurrence of permafrost necessitates major amendments to design principles. In the arctic and subarctic, streams that would ordinarily be available as a source of water supply are frequently frozen solid in winter and at other times are highly laden with glacial silt, making them undependable and impractical. Wells driven through the permafrost zone into water-bearing strata are not only practical, but avoid expensive above-ground storage structures which must be heated and are subject to earthquake shock.

If permafrost extends to indeterminable depths and well driving becomes impracticable, ice cut from ponds, lakes, and rivers is stored and converted by ice-melting plants into water that furnishes a limited or auxiliary supply through the coldest months.

A high iron and manganese content is often found in water from wells driven through permafrost, and treatment for the removal of these minerals as well as chlorination is necessary to provide water suitable for domestic use. Unless unduly high, hardness is removed from the water only when it is used in industrial processes, laundries, and steam plants. Large fire demands are met by pumping directly from wells into the distribution system.

Disposal of raw sewage into tidewater sometimes is not feasible and sewage treatment is required. Two types of sewage treatment have been found well adapted to arctic conditions: (1) Primary settling, digestion, and sludge dewatering either by drying beds or vacuum filters, and (2) primary settling, dewatering of chemically conditioned raw sludge by vacuum filtration. The second method is simpler and more economical. Incineration of the sludge cake by itself or together with garbage and refuse is desirable in both cases.

When heat is distributed from a central heating plant, heating, sewer and water utility lines are carried in a common conduit or utilidor large enough to permit inspection, repair and maintenance. The design and construction of utilidors is covered in the second paper in this symposium, by William L. Hyland and M. H. Mellish.

Steam Heated Conduits—Utilidors—Protect Service Pipes from Freezing

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AT ARCTIC military bases, sanitary problems are currently being solved satisfactorily by the use of underground tunnels containing water, sewer and steam mains; these tunnels or conduits are termed "utilidors." In regions of North America where permafrost exists there are a few long-established communities which, because of their strategic locations, have had a rapid growth in recent years and are now confronted with the problem of developing water distribution and sewage collection systems that are operable the year round. Up to the present time, methods for distributing water and collecting sewage in such civilian communities have been of the hit-or-miss variety and extremely primitive.

At Churchill, Manitoba, a community located in the permafrost belt, sanitary facilities are most primitive. In general, water is obtained by the simple expedient of melting ice which is stored for this purpose by the individual as he stores his fuel. There is, however, a government-owned water supply main, fed from a lake about eight miles away, servicing a few government-owned facilities. The pipeline is above ground and is insulated by a moss covering held in place by a semicircular steel plate. The water is heated to approximately 70 deg F at the source, and by the time it reaches its destination is still a few degrees above freezing. Disposal of waste water from dwellings is by cesspools.

At Fairbanks, Alaska (population 8,500), situated 113 miles south of the Arctic Circle and in the permafrost zone, many of the inhabitants obtain their own individual water supplies from wells of various depths down to 200 ft; others buy bottled water. Here the soil is largely sand and gravel which is water-bearing both below and between layers of permafrost—in contrast to subsurface conditions at Churchill where the subsoil is not suitable for wells. The local public utility company operates a water supply system of limited scope for use in the Fairbanks business district. Two water mains are carried in a buried conduit together with a steam line, the latter for the purpose of maintaining above-freezing temperatures. One main carries non-potable water and the other is a normally dry main serving five fire hydrants. This system is a form of the utilidor system, the term utilidor applying to the enclosing conduit. During the summer the same company operates a surface-laid water system supplying non-potable water to its customers in the more populated areas by means of yard hydrants. This service is discontinued in the fall, and the system is drained.

The main sewer at Fairbanks is a wood-stave pipeline varying from 15 to 24 in. in diameter, laid 6 to 7 ft below the ground surface. The sewer has a continuous flow and does not freeze solid. Service connections are installed with 4 to 5 ft of cover and, as there is no cold-weather protection, many of them freeze solid during the winter months.

TYPICAL BOX-TYPE utilidor system is constructed with cast-in-place invert and side walls. Water and steam lines are suspended from steel beams. Manholes, placed at intersections, or maximum of 250 ft apart, are provided with louvered ventilating shafts.

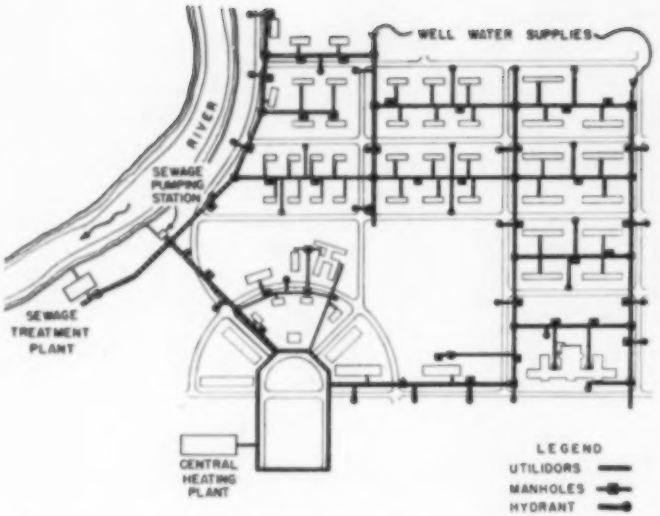


FIG. 1. PLAN SHOWS typical utilidor system designed for community of 3,200 population, served by central heating plant. Steam lines act as radiators to keep water and sewer lines from freezing.

At The Pas, Manitoba, a town located about 100 miles south of the permafrost belt, seasonal frost penetrates to a depth of approximately 9 ft. Water and sewer mains are installed in the ground in a conventional manner and at a depth sufficient to eliminate the possibility of freezing.

Military Utilidor Systems

In recent years it has been necessary to provide adequate utility systems at our military establishments in the arctic and, in general, this experience has indicated the desirability of using utilidor systems. Utilidors for temporary buildings usually are rectangular wooden conduits, corrugated metal pipes, or some other design of a durability equivalent to that of the buildings served. On the other hand, utilidors for a permanent development should be permanent structures of a material such as reinforced concrete.

A typical layout for a utilidor system serving a population of 3,200 is shown in Fig. 1. The system is designed to be extended to serve an ultimate population of 6,000. The buildings are heated from a central power plant; consequently the utilidors are designed to carry the steam distribution mains as well as the water and sewer pipes, as shown by the profile and cross section, Figs. 2 and 3(*a*) respectively. This is a most satisfactory arrangement as sufficient heat is dissipated by the insulated steam supply main to maintain above-freezing temperatures in the utilidor. Approximately 20,000 ft of utilidors, including mains and branches varying in size from 5 ft × 5 ft 6 in. down to 2 ft × 1 ft 6 in., are included in the layout.

The utilidor is a poured-in-place reinforced concrete box with precast sectional and removable covers. Manholes are located at junction points of the main-line utilidor and are equipped with louvered ventilating shafts. Access manholes are spaced about 250 ft apart. The sewer pipe provides gravity flow and controls the depth of the installation, which in this case averages approximately 10 ft to the invert. Interior drainage, including seepage, is collected in a channel recessed in the utilidor floor and flows by gravity to a pump well. In view of permafrost conditions, all soil which is unstable when thawed is removed from the trench, and a mat of coarse but well-graded and thoroughly compacted sand and gravel having a minimum thickness of 24 in. is placed as a subbase and insulating blanket.

Cross sections of alternate utilidors that can be prefabricated in whole or in part are illustrated in Fig. 3. Still other types are under study. The semicircular type is a very satisfactory design in many respects but is slightly more costly than the box type. The invert and side walls up to the springing line are poured-in-place reinforced concrete, while the removable top is nothing more than a half section of centrifugally spun concrete pipe of standard length. The circular type is composed of standard lengths of centrifugally spun concrete pipe split longitudinally. These split sections can readily be manufactured with standard pipe plant equipment. The parabolic section has a poured-in-place invert and a cover of precast vacuum-processed concrete. Based on current United States prices, the estimated costs per linear foot for these structures installed in the ground, but not including the contained utilities, are: (*a*) box type, $35.30; (*b*) semicircular, $39.90; (*c*) circular, $38.40; (*d*) parabolic, $40.70.

As will be noted, the box-type section, which is shown in Fig. 3(a), is the least costly and accordingly is used in the design of the system chosen for illustration in Fig. 1. The estimates of cost are developed from conditions surrounding this particular installation and do not necessarily reflect a cost comparison applicable to all installations.

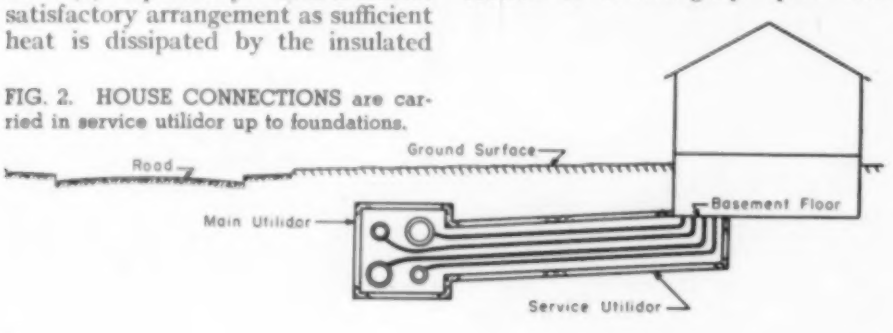


FIG. 2. HOUSE CONNECTIONS are carried in service utilidor up to foundations.

Conventional Utility Systems

Utilidor systems should be considered favorably for permanent utility installations in the frigid zones of North America. In Russia however, for alleged economic reasons, the favored method is to lay the pipes directly in the ground just below the seasonal frost line, where temperatures are relatively constant and only a few degrees below freezing. In such an arrangement the water is preheated and kept moving to prevent freezing. The pipe is laid on a sand or gravel foundation and is backfilled with the same material to a thickness of one diameter above the pipe, followed by an 8-in. layer of peat or other insulating material, after which backfilling is completed with the material taken out of the trench. There is no question concerning the effectiveness of this system; however, it involves the expense of heating and circulating the water to prevent freezing.

If the water distribution system is buried, it follows logically that the sewage collection pipes likewise would be buried. Since a buried-pipe installation, termed a "conventional installation," is entirely practicable, an alternative design based on this method, following the layout shown in Fig. 1, has been prepared for the purpose of comparing its cost with that of a utilidor system. Steam, water, and sewer facilities are included in this design as in the utilidor system.

As the pipes are installed in separate trenches, the heat normally dissipated by the steam installation

is no longer available for maintaining above-freezing temperatures in the water and sewer lines. The water mains, which are laid with a 6-ft cover, are prevented from freezing by being designed as a loop system. The water is heated at the source and kept in circulation by constant pumping. Hydrant connections are insulated and electrically heated. Approximately 10,600,000 lb of steam and 165,000 kwhr of electrical energy would be required in operating the heating and recirculating phases over the anticipated eight months of cold weather.

Sewers in the conventional system have approximately 9 ft of cover and are kept from freezing by bleeding steam condensate into the service connections.

Economics of Utilidor Systems

Economy is or should be a controlling factor in determining the selection between alternative types. As first cost alone does not necessarily indicate true cost relationship, a comparative cost analysis of the two types of systems has been prepared in Table I, based on current United States prices.

Useful life is established in accordance with the 1942 revised depreciation schedule of the U.S. Bureau of Internal Revenue. Salvage value of the various units has been set at zero as it is considered that reclamation cost will offset the potential sale value as junk. Rates of interest on the capital investment and amortization fund have been arbitrarily taken at 3 percent in each case. Fluctuation in these rates, while affecting the total annual cost, would not alter their relative positions. Annual maintenance cost in the case of the utilidor system is taken as one-half of 1 percent of the first cost for the utilidor structure and as 1 per cent of the first cost for the contained utilities. For the conventional system, annual maintenance is $1^1/_4$ percent of the first cost for the steam and water installations and 1 percent of the first cost for the sewer. To a certain degree, these differences in maintenance cost reflect the relative accessibility for repairs.

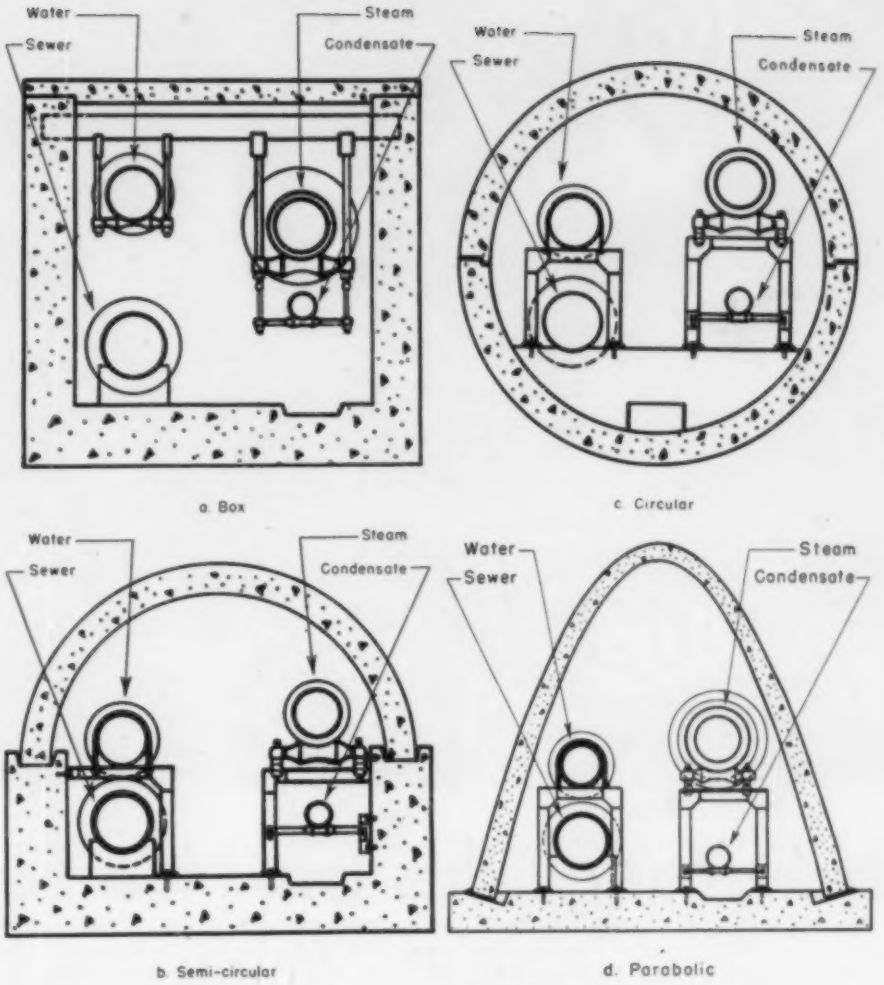


FIG. 3. FOUR TYPES OF UTILIDORS are shown in cross section: (*a*) Box type—side walls and invert cast in place, with precast, removable, sectional cover; (*b*) semicircular—side walls and invert cast in place, with cover of standard centrifugally spun concrete pipe; (*c*) circular section—standard centrifugally spun concrete pipe split longitudinally; (*d*) parabolic section—cast-in-place invert slab and precast vacuum processed cover.

The figure included under annual operating cost represents an estimate of the annual expense involved over and above operating charges normal to both systems; this expense covers heating and circulating the contents of the water mains in the conventional installation.

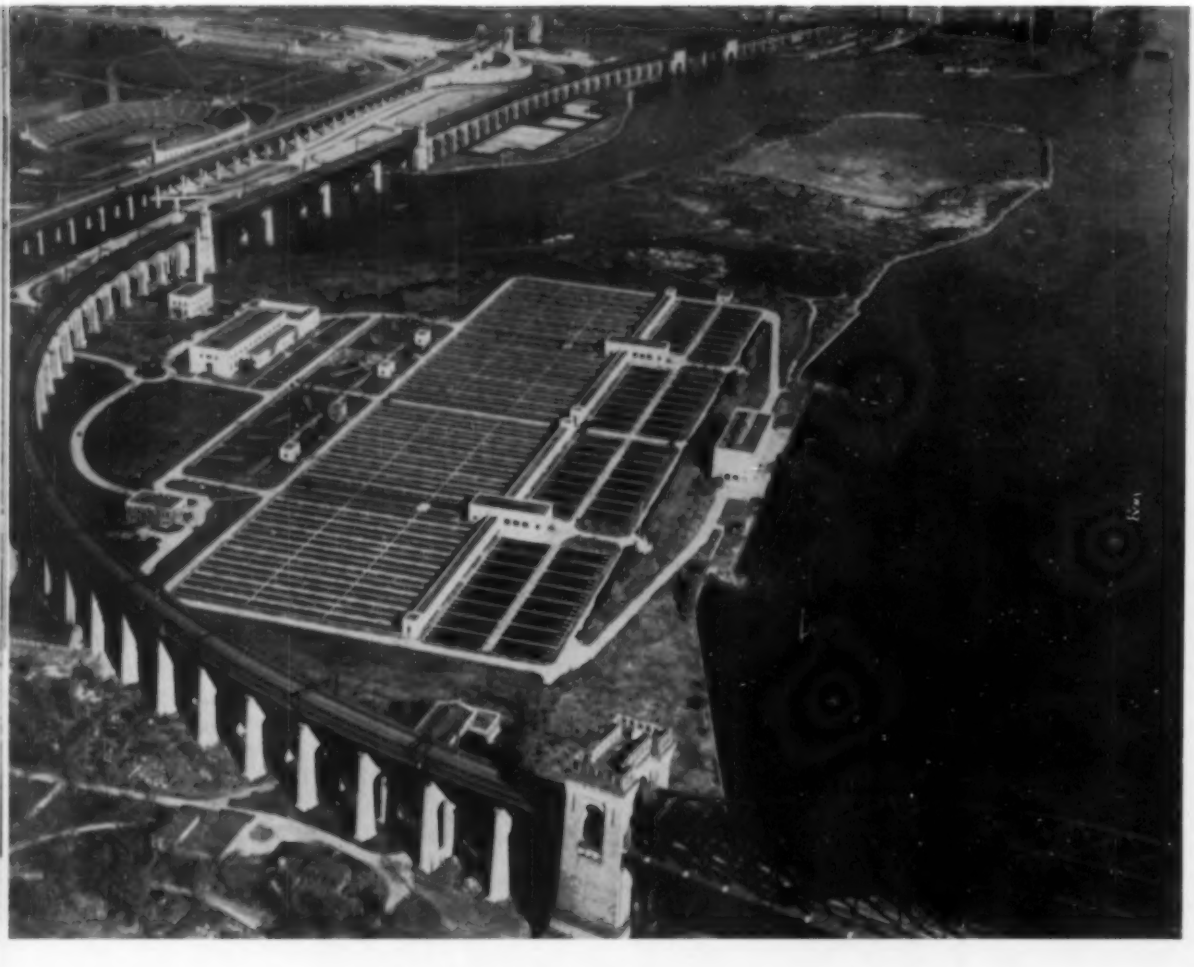
It is interesting to note in comparing the costs of the two systems having steam distribution (Plan I) that, although the first cost of the utilidor system is approximately 65 percent higher than that of the conventional system, it has an advantage of slightly more than 7 percent in annual service cost. This saving is due entirely to the fact that there are no operating charges connected with the utilidor system as such, whereas operating changes represent approximately $34^1/_2$ percent of the annual cost of the alternative design. Operating costs over a period of years are more likely to rise than drop, in which event the economic advantage of the utilidor design would be improved.

The above study is applicable to a typical military base with a central heating plant and a steam distribution system. The ordinary civilian community would not have central heat and steam distribution.

(*Continued on page 73*)

TABLE 1. COMPARATIVE COSTS OF UTILIDOR SYSTEM AND CONVENTIONAL SYSTEMS FOR TYPICAL COMMUNITY OF 3,200

Items	Plan I, with Steam Distribution System		Plan II, without Steam Distribution System	
	Utilidor	Conventional	Utilidor	Conventional
First cost	$826,850	$498,585	$511,006	$244,976
Annual service cost:				
Amortization fund, 3%	12,764	9,462	8,589	2,181
Interest on investment, 3%	24,806	14,958	15,330	7,348
Annual maintenance cost	5,594	5,976	3,337	2,845
Annual operational cost	....	16,024	27,000	43,024
Total annual service cost	43,164	46,420	54,256	55,398



WARDS ISLAND SEWAGE TREATMENT PLANT, in operation since 1937, treats 226 mgd by activated sludge process. Projected extension will increase capacity to 466 mgd. Plant is designed to fit into parklike setting, partially encircled by approaches to Hell Gate Bridge. Extension to plant will be built on fill which is being extended along East River at upper right.

New York Builds Two New Sewage Treatment Plants in Far-Sighted Program

RICHARD H. GOULD
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DESIGNS FOR EIGHT new sewage treatment plants for the City of New York are in various stages of completion, and construction is going forward on two—Owls Head and 26th Ward. Although the city now treats only about 41 percent of its total sewage flow of 1,100 mgd, plans contemplate some type of treatment for the entire flow to protect the many fine waterways which surround the city and constitute one of its great natural advantages. Besides the $72,000,000 spent or appropriated for the treatment program to date, present prices indicate that $200,000,000 additional will be required to bring it to completion. Plans and specifications are available for construction to the value of $80,000,000, but the undertaking of additional plants hinges on the ability of the city to provide funds in the face of other urgent needs and statutory limitations on the debt limit.

OBJECTIVES OF SEWAGE TREATMENT in New York City may be stated very simply. Primarily they are to remove enough of the polluting material discharged with the used water supply so that the receiving waterways surrounding the city will not be offensive to sight or smell, and so that areas used for bathing and other recreation will not be a menace to the public health. Fortunately or not, this is very much the city's own problem for, aside from its neighbors across the river in New Jersey, it alone is affected by its own filth. There are no downstream communities to be affected by it.

Geographical Location Is Important Factor

Sewage disposal problems of seaboard cities, although analogous, can only be solved in light of the special circumstances of each locality. Partly these circumstances lie in the physical conditions of the particular tidal estuary which is available for use. Such matters as the volume of fresh and tidal flows, to dilute, disperse, and carry away the products of decomposition; the percentages of sea water available to coagulate and settle out colloidal matter and bacteria; the surface areas available for absorption of oxygen; the temperatures of the waters; and the nature of the use of the waterways—all are factors influencing the extent and character of the sewage treatment that must be provided.

In New York Harbor, the lower tip of Manhattan is 15 miles from the open ocean. The Hudson, Passaic, and Hackensack Rivers provide fresh water runoff from over 14,000 sq miles. Tidal flows are extensive because of the size of the Hudson River and other local water surfaces, and the relationship of the harbor to Long Island Sound. Salt water intrusion is such as to represent about 50 percent of the water at mid-Manhattan, tapering off to nothing in the Hudson at Poughkeepsie, some 60 miles to the north.

Another example of a tidal estuary—namely, Chesapeake Bay—is pertinent to this discussion because of

limiting conditions that raise new problems. These conditions are related not so much to the degree of treatment of the sewage as to the development of secondary growths following treatment and their effects on the receiving waterways.

Experience at Baltimore

Chesapeake Bay is over 190 miles long. Tributary at the north is the Susquehanna River with its 27,400 sq miles of watershed, about twice that of the Hudson at New York. In the lower reaches are other large rivers such as the Potomac, Rappahannock, York, James, etc. Altogether nearly 80,000 sq miles contribute their runoff of fresh water to the bay.

The city of Baltimore is near the upper end of the bay and about 160 miles distant from the ocean. At Baltimore the tidal range is only about 1 ft; the amount of salt water is relatively negligible; and summer temperatures are high. Baltimore treats its sewage—most of it in trickling filters but some by the activated sludge process—and the effluent is discharged into the Back River. Back River is a shallow estuary of Chesapeake Bay about 5 miles long and a half mile wide, of which the principal inflow in dry weather is the Baltimore sewage effluent. As would be expected, during the displacement period of this effluent in the river, closely approaching a month, nitrates have full opportunity to develop, with consequent prolific growths of algae and other aquatic plants.

That this specific problem may not be general in tidal estuaries where natural conditions are different is shown by the long-term experience of New York in Jamaica Bay. This shallow bay, perhaps about five times the area of the Back River, has a direct connection to the ocean. The tidal range is about 4.5 ft, and about one half the average water volume is replaced during each tidal cycle. In the past, the bay has received the discharges from about 1,100,000 people with little effective treatment. About 60 percent of this pollution has now been removed by treatment and the re-

SETTLING TANKS of Wards Island Sewage Treatment Plant (above) are flanked on left by pump and blower house and on right by sludge pumping stations. Aeration tanks appear in right distance. Shrubs and other planting, as well as general layout of plant, show that sewage treatment plants need not be eyesore in heavily populated areas.

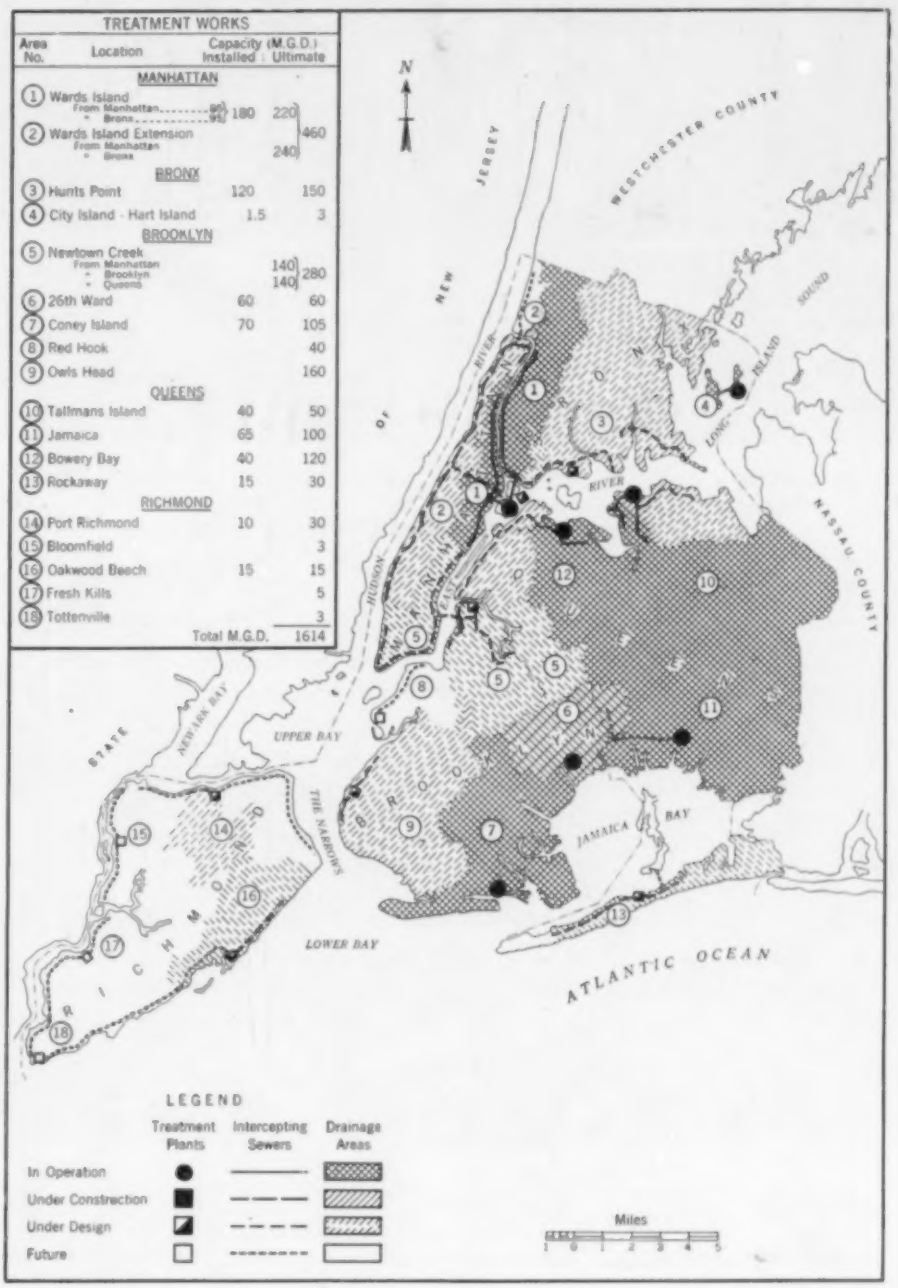


FIG. 1. **SEVEN MODERN sewage treatment plants (handling 415.8 mgd) and six old plants (handling 31 mgd) are in operation in City of New York. (See Table II.) Thirteen new plants are projected to treat 1,031 mgd. Of these, design work has been completed on three (new 26th Ward, Hunts Point and Rockaway); design is in various stages of completion for six; and detailed design has not yet been started on four.**

CONSTRUCTION OF OUTFALL for Owls Head Treatment Plant involves dredging and cofferdam for building of foundations to carry pipeline. Cofferdam for downdrop section appears at right. In foreground is seen part of rock pile secured from Battery Tunnel spoil. Rock is used in dike which forms foundation of sea wall.

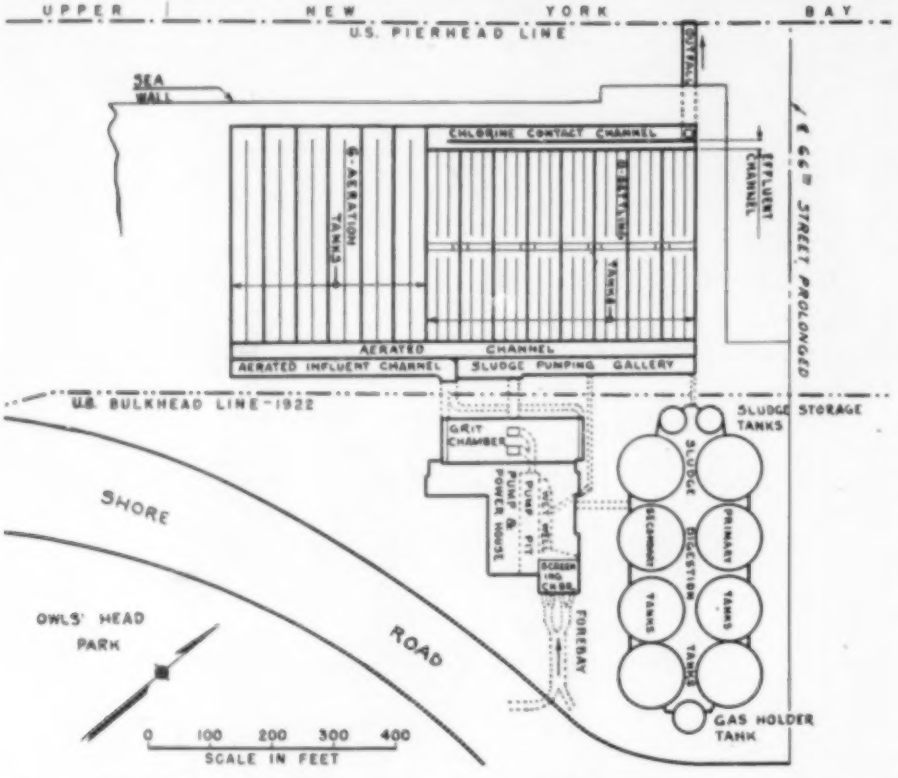


FIG. 2. LAYOUT INDICATES basic design features of Owls Head plant, designed to treat 160 mgd by process of modified sewage aeration, or high-rate activated sludge. Construction cost is estimated at $22,500,000.

mainder is listed for early correction. During times of excessively heavy pollution, offensive conditions have been present, diminishing with the advent of corrective measures. At no time, however, has there been evidence of troublesome secondary growths such as have been reported at Baltimore.

A rather extensive sanitary survey of the harbor has been made each summer from 1909 to date, with the exception of the year 1910. Marked seasonal fluctuations appear in these figures because of variations in stream flow and other meteorological conditions, but the general trend has been a rather sharp decrease in the percentage of saturation of dissolved oxygen in the first years of observation, followed by a more gradual decrease since about 1930.

Present indications are that the downward trend is generally arrested as a result, it is presumed, of the sewage treatment programs in the region. Present conditions in the major branches of the harbor as disclosed by the 1947 survey, appear in Table I.

Favorable Harbor Conditions

Natural conditions in the waterways are in general favorable for the assimilation of sewage and sewage effluents. There is a substantial flow in the Hudson River and its deep channel permits an underrun of tidal flow from the ocean which adds materially to the outgoing current moving polluting material toward the sea. Even so, the time that sewage materials remain within the harbor is very substantial. Under summer conditions it is estimated that discharges from upper Manhattan take about ten days to reach the Battery at the lower end of the island, and over seven days more to pass out of the harbor. From the Battery to Throggs Neck on Long Island Sound it may take 11 to 18 days. While this means that most of the oxygen demand of the sewage is exerted within the harbor limits, it also means that most of the wastes are well stabilized and the bacterial content greatly reduced when the recreational areas on the outskirts of the city are reached.

The large tidal prisms of the harbor, Newark Bay and the Hudson River cause extensive tidal currents. These currents are augmented by the fact that the incoming tide in Long Island Sound takes about 3 hours longer to reach its high at Throggs Neck on the Upper East River than it does passing through the Narrows to the inner harbor from the ocean. The resulting tidal interference creates a tidal range of about 8 ft at Throggs Neck as against 4.5 ft at the Battery. This differential in tidal range and lag in time cause relatively

TABLE I. AVERAGE ANALYSIS OF WATER IN MAIN BRANCHES OF NEW YORK HARBOR, 1947

Analysis		Hudson River	Harlem River	Upper East River	Lower East River	Upper Bay	Narrows	Jamaica Bay	Kill Van Kull
Dissolved oxygen, % saturation	Top	61	32	33	21	36	43	78	31
	Bottom	40	30	35	25	44	55	74	34
B.O.D., ppm.	Top	1.7	2.0	1.6	2.0	3.1	2.0	2.9	2.7
	Bottom	1.4	1.8	1.4	2.0	2.3	1.5	1.9	2.1
Coliform bacteria per ml	Top	37	69	38	68	150	56	17	146
	Bottom	26	54	15	50	140	24	10	68
Salinity, % of sea water	Top	36	47	75	68	67	71	83	62
	Bottom	49	50	77	69	74	80	85	69

steep hydraulic slopes and heavy currents in the East River.

Because of the oscillating nature of all tidal currents in the harbor, these currents are not effective in transporting sediment. Matter that settles out, therefore, remains in the harbor, some of it undoubtedly undergoing anaerobic decomposition with loss of carbon in liquefaction and gasification and some making its oxygen demand on the overlying waters. An analysis of cold and warm water conditions has indicated that fully 25 percent of the summer oxygen demand may be traced to sludge deposits that are relatively dormant in winter.

Of the oxygen resources available to maintain reasonable levels of dissolved oxygen in the waters, that carried by stream flows and tidal flows has important value, but a great part appears to come from the air. In the 25 years since the writer first called attention to the importance of the area of the water surface as a controlling factor in the condition of polluted water, he has not found conclusive evidence to the contrary (see "The Area of Water Surface as a Controlling Factor in the Condition of Polluted Harbor Waters," TRANSACTIONS, ASCE, Vol. 85 (1922), page 699.)

New York City has embarked on a comprehensive plan for the treatment of all its sewage. This plan calls for the construction of 17 sewage treatment works, with some of the separate projects to be advanced in stages. While sewage treatment in what is

TABLE II. SEWAGE TREATMENT PLANTS NOW IN OPERATION IN NEW YORK CITY

Plants and Types of Treatment	Flow Treated August 1947
	Mgd
Modern Plants:	
Wards Island—activated sludge	226
Bowery Bay—activated sludge	37.8
Tallmans Island—activated sludge	21.1
Jamaica—"modified sewage aeration" and chlorination	36.6
26th Ward—screening and chlorination (future, activated sludge)	40.8
Coney Island—seasonal chemical treatment and chlorination	52.7
City Island–Harts Island—sedimentation and chlorination	0.8
Old Plants:	
Hammels—fine screens and chlorination	9.4
South Beach—fine screens and chlorination	3.1
Oakwood Beach—fine screens and chlorination	2.4
Canal Street—fine screens	7.2
Dyckman Street—fine screens	8.3
Neponsit—septic tank	0.6
Total	446.8

AT SITE OF OWLS HEAD Sewage Treatment Plant, tractors distribute earth for fill and stone for rock dike—on which sea wall at right is founded.

WEST SEA WALL of reinforced concrete forms boundary of Owls Head Sewage Treatment Plant on Upper Bay near The Narrows. Bids have just been advertised for additional contracts of 160-mgd plant to employ modified sewage aeration process.

PILE GROUPS, driven in clay and sand to depth of about 50 ft, form foundation for pump and blower house at site of new 26th Ward activated sludge plant in Brooklyn, N.Y. Low-level cofferdam and well points for pumps and wet well appear at upper left. At upper right is old 26th Ward Plant, now limited to screening and chlorination, built in 1895, which will be demolished when new plant is built.

TRANSIT-MIX TRUCK provides concrete for placement by rubber-tired buggies in chlorine storage building under construction for new 26th Ward activated sludge plant. At upper left appear completed settling tanks now in operation. Beyond chlorine storage building appear completed concrete footings and trench for heating and other service lines. Old treatment plant is in right background.

now New York City started some 63 years ago, the program for modern plants started only 18 years ago—in 1930.

The total sewage flow of the city is estimated at 1,100 mgd. About 447 mgd of this flow is being treated in seven modern plants and six old ones that will eventually be given up. The distribution of the flow is given in Table II.

Construction has been resumed on the 60-mgd 26th Ward activated sludge plant in Brooklyn. Work on this plant was held up by the war but construction was sufficiently advanced so that the primary tanks and digestion tanks have been in service for the past four years. The first contract of the 160 mgd Owls Head Plant, also in Brooklyn, is under way. The construction of additional major plants will be contingent on the ability of the city to provide funds in the face of other urgent needs and under statutory limitations that are at the moment quite restrictive. The possibilities of financing the sewage work by special sewage charges has been seriously considered but there appears to be no immediate prospect that this method will be adopted.

Future plants that have been designed or on which designs are progressing are listed in Table III. Projects on which detailed design has not yet been started are:

Red Hook	40 mgd
Tottenville	3 mgd
Fresh Kills	5 mgd
Bloomfield	3 mgd

About $72,000,000 has been spent or appropriated on the program to date and it would appear that under present prices about $200,000,000 more will be required to bring it to completion. Plans and specifications, in completed or partly completed stage, are available for construction work to the value of about $80,000,000.

Four Types of Treatment Planned

In general, four types of treatment plants are called for in New York's future sewage treatment program. First, there are those giving full treatment by the activated sludge process. These plants are either in locations where it is important to remove the maximum amount of B.O.D. loading from the waterways to maintain dissolved oxygen values or in locations in or near Class "A" waters, used for recreation, where it is desired to give the fullest protection to the waters. Activated sludge plants for the most part have been reduced in size by using the principles of "step aeration."

At the other extreme of treatment are simple sedimentation plants, with or without chlorination depending upon location. These are mostly small plants placed where the B.O.D. is not too critical.

The third type of plant is represented by one large sedimentation plant at Coney Island, where sedimentation is supplemented by chemical coagulation and chlorination facilities for use during the summer bathing season. Although there is ample dissolved oxygen available in the adjacent waters, the extra summer treatment is desirable because of proximity to the large bathing beaches.

TABLE III. FUTURE PLANTS FOR WHICH DETAILED DESIGN IS UNDER WAY OR COMPLETED

Plants and Types of Treatment	Capacity, Mgd	Design Percent Complete
Hunts Point—activated sludge	120	100
Rockaway—modified sewage aeration	15	100
Owls Head—modified sewage aeration	160	91
Newtown Creek—modified sewage aeration	280	40
Port Richmond—sedimentation	10	76
Wards Island Extension—activated sludge	240	47
Bowery Bay Extension—activated sludge	80	12
Oakwood Beach—activated sludge	15	6
26th Ward (new plant)—activated sludge	60	100
Total	980	

In the past few years a new type of treatment has been devised and adopted in New York that should give results closely approaching, on the average, the results of the full activated sludge cycle. It is a high-rate activated sludge process, which has been called locally "modified sewage aeration." It is a device for remov-

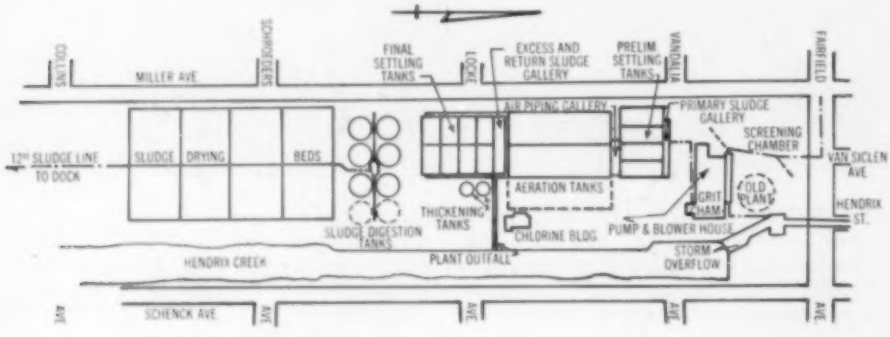
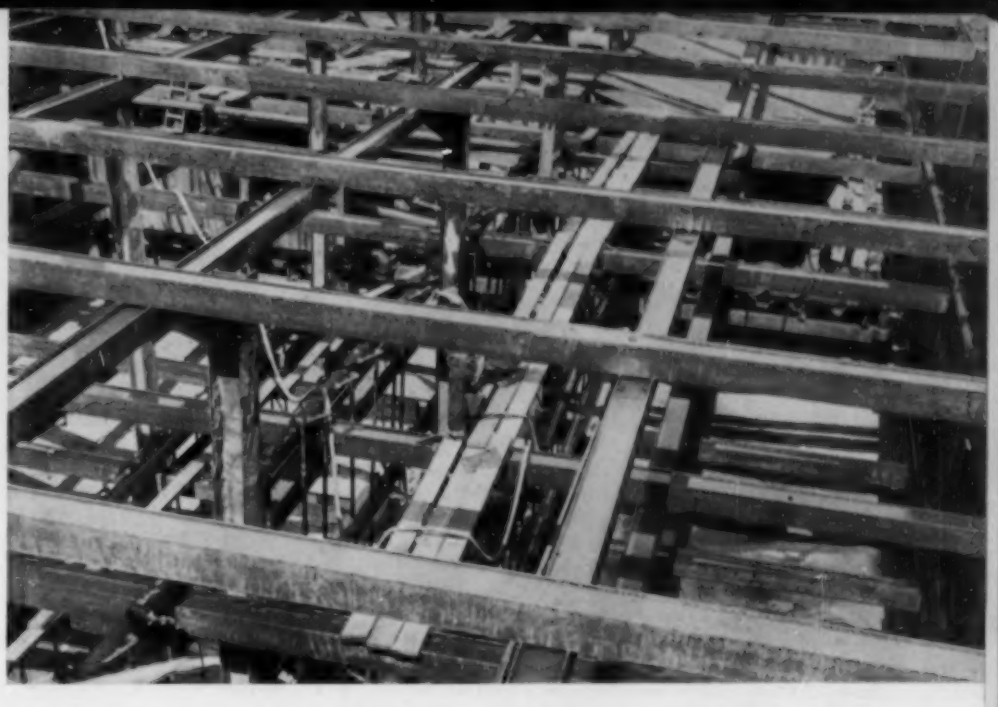


FIG. 3. LAYOUT SHOWS basic features of new 26th Ward activated sludge plant now under construction to replace old plant of same name nearby, which provides only screening and chlorination. New plant, to treat 60 mgd, is scheduled for completion by 1950 at projected cost of $9,240,000.



OW-LEVEL COFFERDAM for pumps and et well is dewatered by means of well points side steel sheetpiling braced by steel cross-eams. Pump and blower house will form art of new 26th Ward Treatment Plant.

g the maximum amount of polluting material at the lowest over-all cost for construction and operation. Plants of this fourth type are to be located in areas where something better than plain sedimentation is desirable and where site limitations and other necessities rule against use of the full activated sludge cycle.

Residue Disposed of at Sea

The program is based on the ultimate disposal at sea of the bulk of the residues of treatment. This method of disposal is by far the most economical one available in the area and its use has proved entirely proper.

Sludge digestion tanks have been provided for all the new plants with the exception of Wards Island and it is expected that this provision will be made there at some future date. The use of sludge digestion tanks is based on the desire to eliminate the hazard of odors from the handling of raw sludges and to take advantage of the reduced volumes that result from the digestion process, so that the residues which are to be shipped to sea will remain as small as possible. The gas resulting from digestion is utilized to the greatest practicable extent in the production of power and heat for use in the treatment processes. The more recent designs for power recovery call for gas engines using the diesel cycle with supplementary fuel in the form of oil.

While there are still many serious pollution conditions to be corrected in the New York area, the works now operating have done much to alleviate the situation and have permitted the advancement of many other worth-while public improvements. The city is becoming ever more conscious of the necessity of carrying to completion its program for furnishing treatment to all its effluent sewage.

Eighteen Million Cubic Yards of Earthfill Forms Texas Flood Control Dam

SAN ANGELO DAM, $18,500,000 multi-purpose structure, controls waters of North Concho River near San Angelo, Tex. Main dam has height of 128 ft and approximate length of over 7 miles, forming reservoir to cover area of 20 sq miles. Project under construction by Galveston District of Corps of Engineers is scheduled for completion in 1951. Ramps which provide access for earth-moving equipment are demolished on completion of work. (See air view of portion of dam at right.) Now under construction by Nolan Brothers Construction Co., of Minneapolis, Minn., is $1,500,000 outlet works, which include gated intake structure, two 18-ft-dia discharge conduits, and stilling basin. Below, left, foundation is poured for intake structure, to be 146 ft high.

CHIPPING END OF 35-ft pile of native hardwood (above, left) provides bond for concrete splice to make up total pile length of 55 ft needed for dock on Lake Maracaibo, Venezuela. After placing of wire mesh, workman Gunites sleeve joint (above, right). Note Gunite already built up in center between pile butts. Joints designed for 5-ft length are made 6 ft to avoid cutting standard roll of wire mesh to narrower width. Corrosive action of lake water prevents use of steel fish plates or steel pipe sleeves for splicing.

Concrete-Spliced Wood Piles Answer Need for 55-Ft Lengths in Venezuelan Dock

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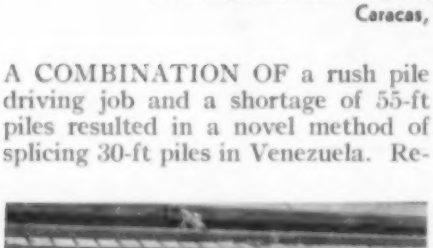
Chief Engineer, Marketing Department, Creole Petroleum Corp., Caracas, Venezuela

A COMBINATION OF a rush pile driving job and a shortage of 55-ft piles resulted in a novel method of splicing 30-ft piles in Venezuela. Repeated tanker collisions with the loading head of a dock in Lake Maracaibo due to shallow water dictated immediate action in extending the dock to deeper water. The 55-ft lengths were required for new breasting and mooring dolphins designed to be 31- and 19-pile clusters respectively, with 25 ft of bottom penetration. Concrete piles were eliminated from consideration by the bending and impact conditions of service, and steel pipes filled with concrete were ruled out because of the acute shortage of pipe.



ALTERNATE GUNITING of two piles (below) permits setting of concrete. With delivery lines of Gunite and water somewhat over 100 ft long, care is required in controlling mixture pressure to permit continuous flow and at same time eliminate excessive sand rebound from cylindrical surface. Close-up (left) shows Gunite partly completed to total 5-in. thickness in splice on Southern pine test pile No. 3.

The solution was the use of timber piles, but none 55 ft long could be obtained immediately. Since plenty of local hardwood ("vera") and imported Southern pine piles in 25- to 35-ft lengths were on hand, splicing was the indicated solution. Because of the extremely corrosive action of Lake Maracaibo water, the use of steel fish plates or steel pipe sleeves was not advisable. The contractors, Heerema and Bomans of Maracaibo, conceived the idea of Guniting a concrete sleeve joint. The original design was reviewed and revised by the writer to provide greater bond and somewhat higher shear and bending resistance. Theoretical calculations of the unusual structure indicated that the joint itself could be made stronger in all respects than the timber pile.

Three Test Piles Prepared

Two designs were prepared—one with a 4-in. concrete thickness, and one with a 5-in. thickness. Two test piles of vera were spliced using a 4-in. ring, and one Southern pine pile with a 5-in. ring. The 4-in. design gave a resistance to bending moment of slightly less than a plain timber pile, while the 5-in. joint was calculated to be some 25 percent stronger than a simple timber pile. The joints were

FIRST TEST OF SPLICED PILE comes when it is picked up by pile driver 14 days after Guniting. Pine pile No. 3 is lifted at point 10 ft from end with no signs of damage (above, left). Hard driving to refusal produced no structural damage to pile, which was then broken by line on top attached to pile-driver winch. Pile (above, center) broke off at mud line, and splice was injured structurally on tension side after failure of pile.

the same with the exception of the concrete thickness. Reinforcing consisted of 12 $^3/_4$-in. longitudinal bars placed inside a cage of No. 10, 4 × 6-in. wire mesh, with five spiral turns of $^1/_4$-in. wire at the top, bottom and center. The $^3/_4$-in. bars were placed so that 2 in. of concrete was outside for corrosion protection.

Layer of Gunite Between Pile Ends

The original design contemplated butting the piles together, but the construction of the test piles was modified to provide a 4-in. layer of Gunite concrete between the ends, as it was found impossible to provide full bearing even with perfect cutoffs of the ends to be spliced. The joints were designed to be 5 ft long, but were constructed slightly over 6 ft in length to avoid cutting a standard roll of wire mesh to a narrower width.

Lehigh high early strength cement was used in about a 3:1 proportion with bank-run sand. Delivery lines of Gunite and water were somewhat over 100 ft long, and some difficulty was experienced at first in controlling the mixture pressure to permit continuous flow, at the same time eliminating excessive sand rebound from the cylindrical surface.

Concrete Cured 14 Days

The joints were Gunited on July 20–22, 1948, and driven 14 days later, although inspection of the concrete revealed little difference after the first seven days of curing. Each of the three spliced piles was almost exactly 55 ft long. The first severe test came when the pile driver picked them up for driving. The driver picked up the piles about 10 ft from one end, while the other end rested on the dock until it was pulled free. The piles with the 45-ft span bowed slightly in the center, but with no apparent damage to the concrete splice.

Driving was done with a drop hammer weighing 3,800 lb, and dropping 4 ft, for a minimum drop energy of 15,000 ft-lb as specified. The pile weights were slightly under 5 tons each, including the concrete joint.

Piles Driven and Tested

The first pile driven was of vera, and had a 4-in. concrete sleeve. The pile was extremely crooked and probably because of poor bond the splice shattered during driving under a drop energy of 35,000 ft-lb.

The second pile driven was similar in all respects to the first, except that the vera piles were fairly straight and uniform. A maximum drop energy of 40,000 ft-lb was employed, and the concrete showed no signs of structural damage. Small hair cracks were noted at the upper and lower ends. After driving to refusal, a line from the pile driver was fastened on the top of the pile, and the pile bent to test the joint in flexure. With a maximum pull of five tons, equivalent to a bending moment of about 300,000 lb-ft, the concrete splice broke up completely. The $^3/_4$-in. longitudinal bars pulled out, but remained in unbroken although overstressed condition. The failure was apparently due to insufficient bond.

The third pile was Southern pine, of uniform straightness, and was spliced with 5 in. of Gunite concrete. No structural damage was noted during hard driving to refusal. The pile was then broken by a line on the top attached to the pile-driver winch. This time the pile broke off completely at the mud line, below the splice. The splice was injured structurally on the tension side, exposing the reinforcing, but only after the timber pile had failed.

Tests Prove Practicability of Splicing

The pile tests indicated to our satisfaction that the theoretical calculations were correct, and that for piles having butt and tip dimensions in the 14- to 10-in. range, a Gunite joint having 5-in. walls should be used.

TWO CONCRETE-SPLICED PILES undergo test on shore of Lake Maracaibo. At far left appears test pile No. 2, of native vera wood, which has been partly driven and awaits new driving collar. In foreground is test pile No. 3, of Southern pine, which is about to be pulled, after being driven and subjected to bending test.

It appears from the driving and bending tests that the splice can be made even stronger by the following procedures:

1. Increasing steel-to-concrete bond through the use of more longitudinal reinforcing bars of smaller diameter, with same total steel area; and by using deformed bars such as "Hi-Bond" with end hooks.
2. Increasing the timber-to-concrete bond through the use of welded wire mesh nailed to the timber instead of gouging holes in the timber.
3. Increasing the spiral reinforcing to cover the entire length of the splice to prevent vertical tension cracks.

Adapted to Mass Production

The process lends itself admirably to mass production, by using vertical forms for prefabricating the reinforcing cages, and an overhead crane for picking up the completed spliced piles. The contractor's estimated cost of the spliced piles would have been about $33 each, or $0.60 per ft of length, which was thought quite reasonable in view of Venezuela's inflated prices. The contractors, P. S. Heerema and R. P. Bomans, are to be given full credit for the development of the idea and execution of the tests, which were carried out under the supervision of the writer.

Formula for Velocity at Beginning of Bed-Load Movement Is Reappraised

F. T. MAVIS, M. ASCE, and L. M. LAUSHEY, Jun. ASCE

Respectively Professor and Head of Civil Engineering Department, and Assistant Professor
Carnegie Institute of Technology, Pittsburgh, Pa.

BOTH THE CIVIL ENGINEER and the scientist are sometimes interested in the question, "Under what conditions will the material of a streambed begin to move?" The answer must be judged from physical data. No other answer is tenable to the engineer regardless of plausible hypotheses or erudite deductions. The answer may be judged from field data, but here the variables are usually uncontrolled and inseparable. Yet, until laboratory methods had been developed, field observations provided the only answer. River control, irrigation, and harbor works that have survived or failed through the centuries may reflect in part judgments reached from observations of raw field data.

A better understanding of the phenomena attending competence—or incipient bed movement—can be acquired in the laboratory than in the field. Although the problem is necessarily idealized in the laboratory, some variables can at least be controlled and experiments can be repeated. Yet laboratory tests can only *suggest* an answer; they cannot *predict* it. The exercise of judgment is essential to foretell under what conditions the material of a streambed will begin to move whether the answer is sought in field data, laboratory data, or analyses correlating one with the other.

Figure 1 is a skeleton outline of the physical factors which enter into consideration of competence—that limiting state in which a material comprising a streambed is in a state of incipient motion. Competence is the threshold between "no load" and "load." It depends on the streambed, the water, and how it flows—and temperature is at least one essential link between the last two. The streambed may be characterized by its shape and composition. This paper deals only with plane, level beds of rectangular section, and with cohesionless bed materials that are unigranular or, within relatively narrow limits, granular mixtures.

The water is assumed to be clear and at room temperature. The flow, within the limits of the experiments reported, is quasi-uniform, that is, as uniform as practicable in open laboratory conduits of rectangular cross section. A complete understanding of the phenomena affecting competence would have to be backed by field and laboratory observations extending beyond the framework skeletonized in Fig. 1.

Newton's three laws of motion are well known, and probably no one today would deny their applicability to hydraulics and to this problem. Newton's four rules of reasoning in philosophy[1] are probably less well known, and yet they suggest pointedly an approach to the study of incipient bed movement. These four rules may be paraphrased as follows:

1. Reduce "causes" to a minimum.
2. Be consistent in associating "cause" and "effect."
3. Assume those qualities of a body that are invariable within the range of the experiments to be universal.
4. Don't evade by hypothesis the argument of induction. Use propositions inferred from phenomena by general induction until such time as other phenomena occur by which they may be made either more accurate or liable to exceptions.

Consider steady, uniform flow of clear water across a level bed of unigranular, cohesionless material. As the velocity at or near the bottom of the channel increases gradually (beginning from rest) there is a state, if the velocity becomes high enough, at which individual grains comprising the bed begin to twitch; and if the velocity is further increased sufficiently they are moved along by the water. To be sure, other things change as the velocity changes: the depth of flow may become less, the slope greater, and the product of the two may perchance remain unchanged. But individual grains could be set in motion by water flowing in a closed conduit as well as in an open channel, or in localized areas where the velocity is adequate to cause movement. Thus the proposition may be induced from observation of laboratory phenomena that:

> Velocity (or some function of velocity) at or very near the bed of the channel is the primary cause of the setting in motion of individual grains of bed material.

Other "primary causes" have been advanced, but bottom velocity (or some function of it) has the advantage of being potentially valid in open or closed conduits of almost any length or surface slope. For all its other shortcomings, "bottom velocity" has the advantage of being easily visualized, "universal" in being applicable to open or closed conduits, and a first approximation in satisfying the rule of "minimum causes."

[1] Sir Isaac Newton's *Mathematical Principles of Natural Philosophy and His System of the World*, translated into English by Andrew Motte, 1729. Translation revised by Florian Cajori. University of California Press, Berkeley, 1946, pp. 398–400.

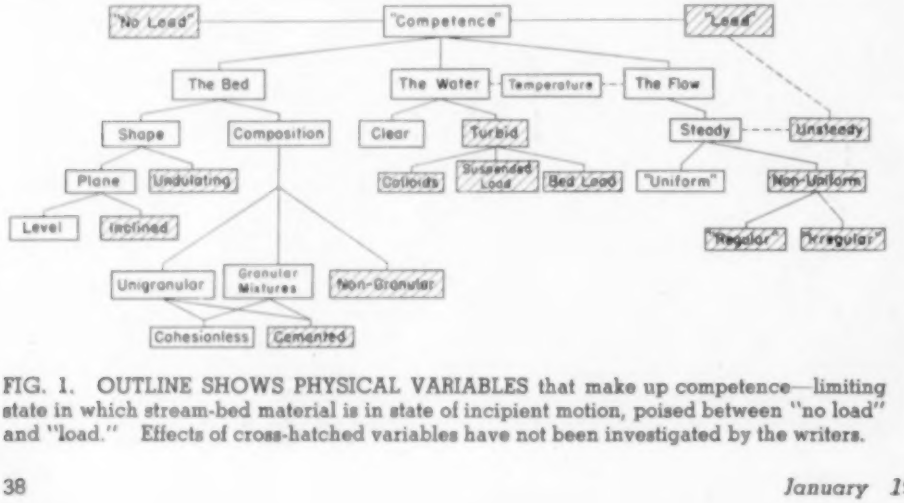


FIG. 1. OUTLINE SHOWS PHYSICAL VARIABLES that make up competence—limiting state in which stream-bed material is in state of incipient motion, poised between "no load" and "load." Effects of cross-hatched variables have not been investigated by the writers.

Other propositions can readily be induced from observing phenomena of bed-load movement in the laboratory and these are well known:

The "bottom velocity" which will cause a heavy grain to move on its bed of similar grains is a function of the size of the grain and of its apparent specific gravity.

A "theory" of competent bottom velocity can be projected on the basis of these two inductions and Newton's laws of motion as follows (tacitly assuming unigranular, cohesionless bed materials):

The tractive force T on a grain varies directly with the hydrodynamic pressure on the grain, and with the projected area of the grain:

$$T \text{ varies as } (\rho V^2 d^2)$$

where s is the mass-density of the fluid, V is its velocity relative to the grain, and d is the grain diameter.

The resisting force R on the grain varies directly with its weight in water:

$$R \text{ varies as } [\rho(s-1)d^3]$$

where s is the apparent specific gravity of the grain material. If the grain is in the state of incipient motion (namely, competence) the tractive force and the resisting force are just balanced and it follows that the competent bottom velocity,

V_b may be anticipated to vary as

$$\sqrt{d(s-1)}.$$

To test this "theory" in the laboratory or in the field would involve some such steps as these:

1. Select a short reach of stream where the section and the bed materials do not vary significantly, and where bed materials are just beginning to drift. (This is simple enough in the laboratory but it may be very difficult in the field.)

2. Observe the velocity near the streambed as a function of depth in this reach.

3. Determine the mechanical analysis and specific gravity of a sample of the bed material that is in a state of incipient motion.

4. Correlate velocity, grain size, and apparent specific gravity to determine a working basis for estimating relationships at competence.

Figure 2 shows the competent velocities reported by DuBuat (1786), Bouniceau (1845), Blackwell (1857), Sainjon (1871), Suchier (1874), and Gilbert (1914) plotted as ordinates. Abscissas are grain sizes. Sizes were estimated from descriptions of materials in data reported by DuBuat, Bouniceau, and Suchier.

Figure 3 shows the results of tests by Gilbert (1914), by Schaffernak (1922), and by graduate students who worked under the direction of one of the authors (Dr. Mavis) at the State University of Iowa, namely: Chitty Ho, Yun-Cheng Tu, Te-Yun Liu, and Edward Soucek. Velocities shown in Fig. 3 were adjusted to be consistent with a material that has an apparent specific gravity of 2.65 by multiplying by $\sqrt{1.65/(s-1)}$, the observed competent velocity for materials with specific gravity s.

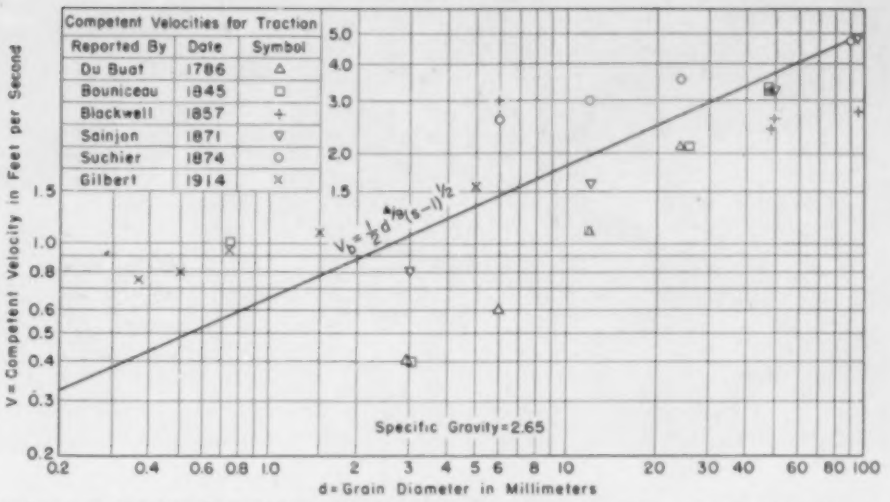

Competent Velocities for Traction
Reported By | Date | Symbol
Du Buat | 1786 | △
Bouniceau | 1845 | □
Blackwell | 1857 | +
Sainjon | 1871 | ▽
Suchier | 1874 | ○
Gilbert | 1914 | ×
$V_b = \frac{1}{2} d^{4/9}(s-1)^{1/2}$
Specific Gravity = 2.65
V = Competent Velocity in Feet per Second
d = Grain Diameter in Millimeters

FIG. 2. DATA REPORTED BETWEEN 1786 AND 1914 are plotted to illustrate formula for competent bottom velocity proposed by Dr. F. T. Mavis, M. ASCE, in 1935.

Figures 2 and 3 show the formula for competent bottom velocity proposed by Dr. Mavis in 1935:

$$V_b = \frac{1}{2} d^{4/9}(s-1)^{1/2}$$

in which V_b is the competent bottom velocity of water in feet per second; d is the diameter of grain (assuming essentially unigranular material) in millimeters; and s is the apparent specific gravity of the material. This formula is in somewhat better agreement with the lower limits of laboratory observations than the simpler formula,

$$V_b = \frac{1}{2} d^{1/2}(s-1)^{1/2}$$

suggested herein. Yet either formula may be used as a first approximation to the competent bottom velocity reported from the various sources.

In submitting this reappraisal of competent velocity as the primary criterion of the beginnings of bed movement, the authors have not investigated the effects of the variables shown cross-hatched in Fig. 1. Yet for "steady, uniform flow of clear water at room temperature across a level bed of cohesionless, unigranular material, this first approximation

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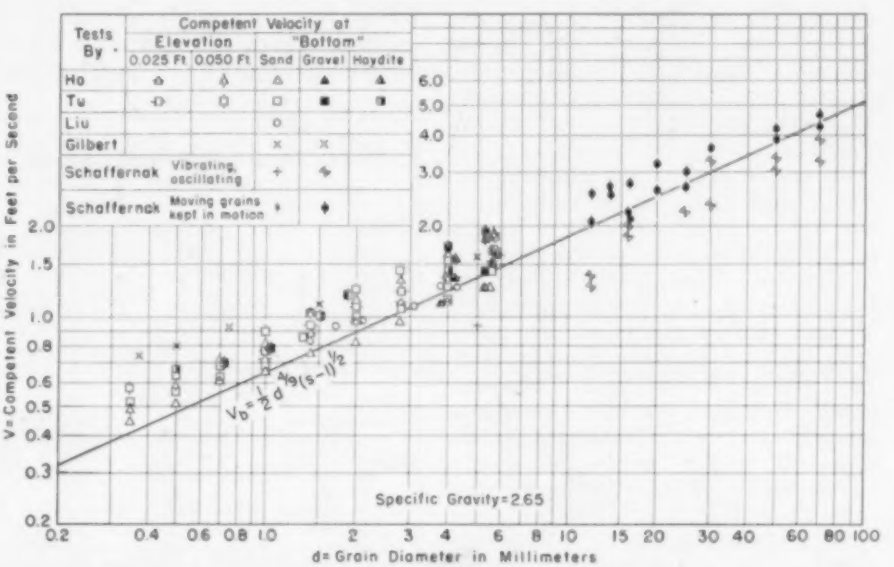

FIG. 3. RECENT DATA (1914–1937) show same close correlation between results of research and formula for competent bottom velocity as is demonstrated in Fig. 2.

PODOLSKO BRIDGE over Vltava River, Czechoslovakia, has unique design feature in that two spandrel arches are supported at quarter points of main arch. In total deck width of 27 ft 11 in., bridge carries two lanes for vehicular traffic, 19 ft 9 in. wide between curbs, and sidewalk 4 ft 1 in. wide on each side.

Contractor Meets Close Design Tolerances in Building Long-Span Concrete Arch Bridge

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Consulting Engineer,
Berkeley, Calif.

ACCURATE CONSTRUCTION of high centering was necessary in building the longest reinforced concrete arch span in Central Europe—the Podolsko Bridge over the Vltava River, Czechoslovakia. The camber required to obtain the predetermined shape of the main arch—of 498-ft theoretical span—was calculated by considering all possible permanent and elastic settlements of both centering and arch. Load tests on the finished arch showed that the actual elastic deformations were considerably lower than calculated. The total deflection of the arch at the crown, after removal of centering, was only 5 in. The photoelastic stress analysis of this highly statically indeterminate structure was made by Dr. Polivka. He here describes the design and the carefully coordinated construction procedure, as well as the loading and deflection tests.

SEEKING ECONOMY in the use of steel and other materials, Europe has forged ahead in the design and construction of reinforced concrete arch bridges. In fact, Europe has 15 such bridges with longer spans than the longest in this country (see box). Although by no means at the top of the list in point of length of center span, the Podolsko Bridge in Czechoslovakia is unique because its long spandrel arches are supported at the quarter points of the main span. This concrete arch bridge over the Vltava River, near Podolsko, South Bohemia, exceeds America's longest concrete arch—George Westinghouse Bridge over the Turtle Creek Valley, East Pittsburgh[1]—by more than 70 ft.

Started early in 1938 the Podolsko Bridge was not completed until 1941 owing to difficulties under the Hitler regime and unfavorable weather conditions. With a total length of 1,680 ft, the bridge consists of a center span 492 ft clear between abutments and of eight flanking spans, 121 ft each, two of them over the left and six over the right river bank (Fig. 1). The elevation of the horizontal roadway over the normal water level is 186 ft, and the rise of the center span is 138 ft. Unusually high piers suggested the original scheme of the center span with two spandrel arches of the same clearance as the flanking spans. The new bridge replaced an old chain bridge of 285-ft span, one of the first suspension bridges in Czechoslovakia, built in 1848.

A series of studies by the Ministry of Public Works in Prague preceded the final design. Two box arches with variable thickness (depth) were considered first, with spandrel arches of the same type, but with hinged supports, in order to eliminate the unfavorable effects of shrinkage and temperature stresses. The idea of hinged supports was abandoned as less economical, and the final design provides a solid concrete arch of uniform thickness (6 ft $6^3/_4$ in.), equal to $^1/_{78}$th of the span, with rigid supports and connections throughout. The width of the arch slab increases gradually from 23 ft at the crown to $31^1/_4$ ft at the springing points. The superstructure consists of $5^1/_2$-in. slab and five longitudinal beams, 12×30 in., resting on transverse walls, 6 in. thick and $23^2/_3$ ft apart, which are stiffened with monolithic columns 12×20 in.

World's Longest Reinforced Concrete Arch Spans

Bridge	Location	Span Length
Sandoe	Sweden	866 ft
Esla	Spain	688 ft
Plougastel	France	612 ft
Traneberg	Sweden	594 ft
LaRoche-Guyon	France	530 ft
Podolsko	Czechoslovakia	492 ft
Svinesund	Sweden-Denmark	492 ft
Bern	Switzerland	492 ft
Castelmoron	France	471 ft
Teufelsthal	Germany	452 ft
Caille	France	450 ft
Kraezern	Switzerland	440 ft
St. Pierre-de-Vauvray	France	432 ft
Faerjsund	Finland	427 ft
Eschelbach	Germany	426 ft
George Westinghouse	Pittsburgh, Pa.	418 ft

[1] "Building America's Longest Concrete-Arch Bridge," *Engineering News-Record*, July 21, 1932, p. 67.

CENTERING FOR MAIN ARCH of Podolsko Bridge is of great importance and must be coordinated with structural arrangement whereby main arch supports two spandrel arches. Centering is built of timber except for three-hinged steel arch at center, with 114-ft span length and 31-ft rise. Four three-hinged steel centering arches, each composed of two arch trusses, stand side by side to support top section of main concrete arch form. New bridge replaces old chain bridge of 285-ft span, built in 1848, here seen in right foreground.

The total width of the deck is 27 ft 11 in., with two lanes for vehicular traffic, 19 ft 9 in. wide between curbs, and two sidewalks on each side, 4 ft 1 in wide, protected by 4-in. railing walls of reinforced concrete. The total deck area is 47,888 sq ft and the cost of the bridge was 14 million Czechoslovak crowns, which amounts to $9.75 per sq ft, calculated on the basis of the exchange rate in 1938–1942 ($1 = 30 crowns). For comparison with the construction cost in the United States, this unit cost should be increased by approximately 175 percent, to $27 per sq ft. since the wages in Czechoslovakia at the time of construction were about 20 percent of those paid in this country, but the cost of materials was approximately the same.

It may be of interest to compare these figures with corresponding data for the George Westinghouse Bridge. The four-lane deck of this bridge, with two 7-ft sidewalks, is 56 ft wide and 1,524 ft long so that the total deck area is approximately 85,500 sq ft. The cost was $3,606,000, which amounts to $42.25 per sq ft.

After the liberation of Czechoslovakia in 1918 the Ministry of Public Works was exclusively carrying on all projects of public interest, but very soon had to comply with the petition of professional engineers to put them in charge of all major designs. So in this case the Bridge Department, headed by Antonín Brebera, one of the most prominent bridge engineers, limited its activity to preliminary investigations and general layout, and put in charge of the complete detailed project Dr. Jan Blažek, civil engineer of Prague.

Photoelastic Model Tests

To corroborate the intricate structural analysis, Dr. Blažek made model tests by using the deformeter method of the late Prof. George E. Beggs, M. ASCE, of Princeton University, which he modified for special purposes. Independently, the author made a thorough photoelastic stress analysis on a large model, 5 ft long, made of a plastic with high optical sensitivity, applying his improved method of determining the stress components directly from isochromatic fringes.[2]

The bridge was designed for loading I of Czechoslovakia's Standard Specifications for Highway Bridges, revised in 1937, consisting of one 26.5-ton steam roller, two trucks of 13.2 tons each, and a uniform load of 82 lb per sq ft, or 820 lb per lin ft of lane.

The waterproofing of the roadway consists of one layer of asphalt felt and one layer of asphalt jute solidly mopped between with hot asphalt and covered with four layers of hot Mexican asphalt. The protective cement mortar finish is $1^3/_{16}$ in. thick and serves as base for the 2-in. granite cubes used as pavement and for granite curbs 8×7 in. in section. Sidewalks are paved with asphalt pavement $1^3/_{16}$ in. thick.

The deck slab is continuous over five supports. For dynamic effect, the impact fraction of 40 percent of the live load was taken into consideration. The slab is reinforced with bars of $^{11}/_{16}$-in. diameter, 5 in. from center to center at the bottom and 10 in. at the top. The total dead load is 120 lb per sq ft.

The deck beams also are continuous over five supports. They are designed for an impact ratio of 30.7 percent. These 12×30-in. deck beams are reinforced with $1^1/_8$-in. deformed (Roxor) bars. Supporting 6-in. walls have double reinforcement of 0.39-in.-dia bars (a little thicker than $^3/_8$-in. bars), spaced 8 in. from center to center each way (vertical and horizontal). Five stiffening columns, 12×20-in., are symmetrically reinforced with $1^1/_8$-in. Roxor bars.

The center line of the main arch approximately follows the line of maximum pressure due to dead load. A considerable deviation occurs at the supports of the spandrel arches, and the effect of this irregularity was tested on models with deformeters and by photoelastic methods. For architectural reasons the sudden change in the compression line was corrected by two curves of the third degree.

Maximum stress in concrete was 812 psi; in steel, 12,300 psi (allowable

[2] "A More Exact Method of Determining Stresses from Photoelastic Isochromatics and Isoclinics," Polivka and Eberhart, *Proceedings* of 15th Semi-Annual Eastern Photoelasticity Conference, Boston, Mass., 1942; "Analysis of Gravity Load Stresses by Photoelastic Methods," J. J. Polivka, *Proceedings* of 16th Semi-Annual Eastern Photoelasticity Conference, Illinois Institute of Technology, Chicago, November 1942.

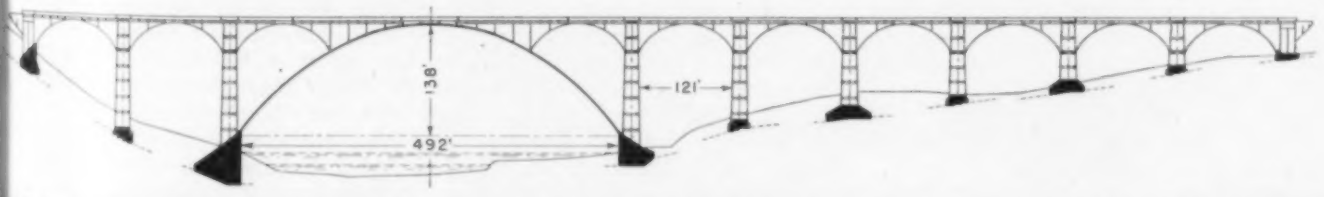


FIG. 1. LONGITUDINAL CROSS SECTION of reinforced concrete Podolsko Bridge shows main design features. Main arch has uniform thickness of 6 ft $6^3/_4$ in. Bridge, 1,680 ft long overall, has hollow piers. Alternate piers of flanking spans have enlarged foundations to take side thrust of adjoining arches.

CONCRETING OF CENTER ARCH started at springing points and proceeded gradually according to plan which provided seven closing sections, the seventh being at the crown. In view above, arch has been freed from centering in preparation for load tests to determine its structural safety before proceeding with construction of rest of bridge.

27,000 psi). Secondary stresses are relatively low as compared with stresses due to dead and live load. The temperature range of 59 deg F increased the compressive stress in the concrete at the crown section from 765 to 793 psi. For a temperature drop to −4 deg F, which is provided for in the specifications and takes into account the shrinkage effect, the compressive stress in the concrete at the springing points was increased from 740 to 820 psi, and to 960 psi under the simultaneous wind pressure of 30.7 lb per sq ft.

For reinforcement, high-strength deformed Roxor bars with the following properties were used: Ultimate strength, 72,000 to 93,000 psi, yield point 54,000 to 69,000 psi, and 20- to 27-percent elongation. The average reinforcement of the center arch is 0.95 percent of the gross sectional area. Roxor bars of 2 $^1/_2$-in. diameter were used for the main reinforcement, with 3.16-sq in. cross-sectional area, 8-in. perimeter and weight 10.7 lb per lin ft, spaced 13 in. at the bottom and at the top, with additional bars at the springing and quarter points. The ultimate strength of the concrete varied from 4,900 to 6,200 psi, considerably higher than the specified value of 3,560 psi for the allowable stress of 1,000 psi.

Solid Arch of Constant Thickness Chosen

Theoretical and experimental analyses have shown that a solid concrete arch of constant thickness throughout fully satisfies all the requirements of present engineering knowledge. Especially important is the fact that the stresses due to elastic and plastic deformation in such an arch are lower than in an arch with increasing cross section toward the springing points or with a box-shaped section.

For the flanking and spandrel arches, two methods of construction were considered in the design: (1) Pouring the arch and superstructure monolithically so that both structural parts would act together as a whole; (2) Pouring the arched superstructure after the centering of the main arch was removed. The second method was decided on as being more economical because of the opportunity for repeated use of the prefabricated centering.

Bridge piers have a width of 23 ft except the end piers, which are 22 ft 3 in. wide. This unusual width was proposed primarily for architectural reasons and for greater stability. The piers are hollow for greater economy and reduction of soil pressure. Every second pier of the flanking spans was calculated for side thrust of the arches and consequently has a larger foundation. All piers have the same structural scheme. The top section, approximately 40 ft high, is stiffened at the springing lines of flanking arches by horizontal slabs. The thickness of the pier walls increases from 12 to 24 in. in sections approximately 20 ft high where the walls are stiffened by horizontal rectangular frames. The maximum reinforcement is 1 percent of the cross-sectional area.

All effects due to the complex continuity of longitudinal deck beams on elastic supports had to be determined, and in this work model tests and photoelastic analyses were invaluable.

Construction Procedure for Centering

Centering of a long-span arch bridge is of great importance. In this case, its design had to be coordinated with the unique structural arrangement whereby the main arch supports two spandrel arches at the quarter points of the span. Four three-hinged steel arches 114 ft in span length with a 31-ft rise were used as centering for the spandrel and flanking arches. Eight similar arched trusses were provided for the center part of the main centering, spaced transversely 3 ft 3 in. on centers.

The rest of the centering consisted of wooden trusses, ten on each side, with the same spacing (3 ft 3 in.). The 4-in. planks were nailed to 8×12-in. continuous chords supported by radially arranged posts, 6×8 in. and 8×8 in., sufficiently braced. Hardwood shore blocks rested on 10×8-in. beams fastened to wooden trusses with metal connectors. For this part of the centering, 160 removable supports, each designed for 50 tons, were provided. The steel trusses rested on 16 adjustable supports, each safe for 150 tons. The contact area of the shoring blocks was increased with No. 24 (9-in.) channels, 3 ft 3 in. long. Concrete piers on piles carried the load of the centering to the ground.

Before designing the bridge foundations, the bearing capacity of the soil was tested by applying load on a circular concrete slab, of 11-ft 9-in. diameter. The load was gradually increased at 10-min intervals by 1 ton per sq ft. Since the subgrade was partly deteriorated granite with relatively low compressibility, the maximum settlement was only $^5/_{32}$ in., less than the specified limit of $^1/_4$ in. It was found that the subgrade of the bridge would safely bear 7,700 lb per sq ft.

The contracting firm, Ing. B. Hlava, Prague, began to install construction equipment in June 1938. Five of the eight flanking arches were concreted in nine phases—one at the crown, two at the springing points, two at the quarter points, and four closing sections. Concreting of the remaining three arches proceeded from the crown toward the springing points continuously, because of the considerable height of the centering. Repeated use made it necessary to remove the steel centers as soon as

the specified compresssive strength of concrete was proved by tests, after two to three weeks. The measured settlement averaged 0.235 in. at the crown, less than the calculated value of 0.275 in.

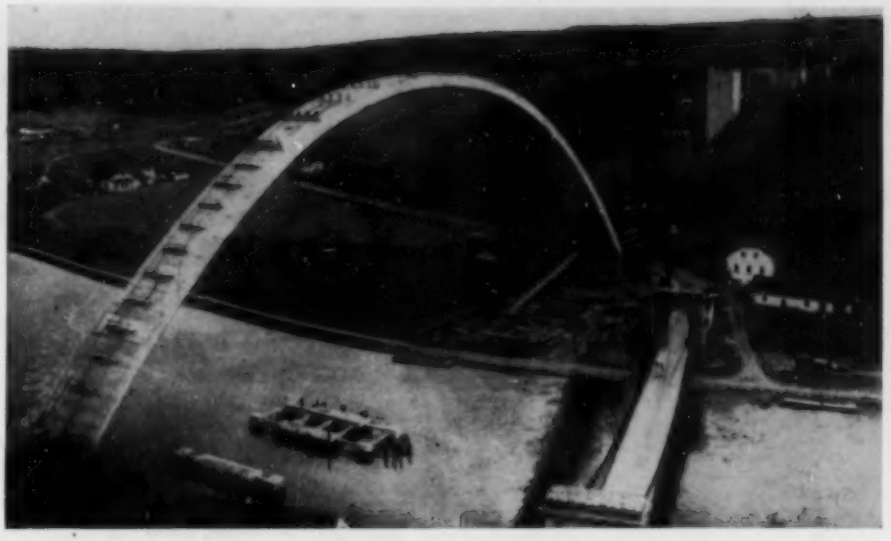
Construction of Main Arch

Erection of the centering for the center arch began on April 25, 1939. The camber necessary to obtain the predetermined shape of the arch in accordance with design and stress analysis was calculated by considering all possible permanent and elastic settlements of both centering and arch, and consisted of $2^{17}/_{32}$ in. for the settlement of the centering; $^{1}/_{4}$ in. for the elastic compression of piles with an additional 2 in. for their permanent settlement; and $^{11}/_{64}$ in. for the elastic deflection of the arch under half live load extended over the whole span, which makes a total of $4^{15}/_{16}$ in. For safety this value was increased to $6^{11}/_{16}$ in. at the crown and to $6^{13}/_{32}$ in. at the quarter points of the span where the spandrel arches are supported.

Concreting of the center arch started on October 27, 1939, at the springing points on both sides and proceeded gradually according to a scheme which provided seven closing sections. The last closing section, at the crown, was completed on December 14, 1939. The main sections were poured independently, leaving gaps between them, which were later filled by the closing sections. Anchorage of sections was obtained by welding the main reinforcing bars together and inserting concrete blocks, 10×12 in. in section and reinforced with eight $^{1}/_{2}$-in.-dia bars.

Freezing weather during concreting made it necessary to install a heater in the concrete mixer and to protect the mixing plant with canvas. The aggregates of the closing sections were preheated and so was the mixing water. The temperature of the poured concrete never dropped below 12 deg F, and increased during the hardening process up to 111 deg F, three days after pouring.

Unexpected low temperatures during concreting caused considerable shortening of the center line of the arch and consequently higher pressures on the centering. It was feared that irregular settlement of some supports would cause excessive tensile stresses in the arched slab, but no cracks were observed. The centering yielded $4^{1}/_{2}$ in. and the total deflection of the arch at the crown, after the centering was removed, was 5 in.



COMPLETED MAIN ARCH is subjected to loading tests before proceeding with construction of spandrel and flanking arches. Forty-ton concentrated load applied at quarter point on each side of arch separately produced elastic deformations which were practically identical, thus proving uniformity of materials and workmanship.

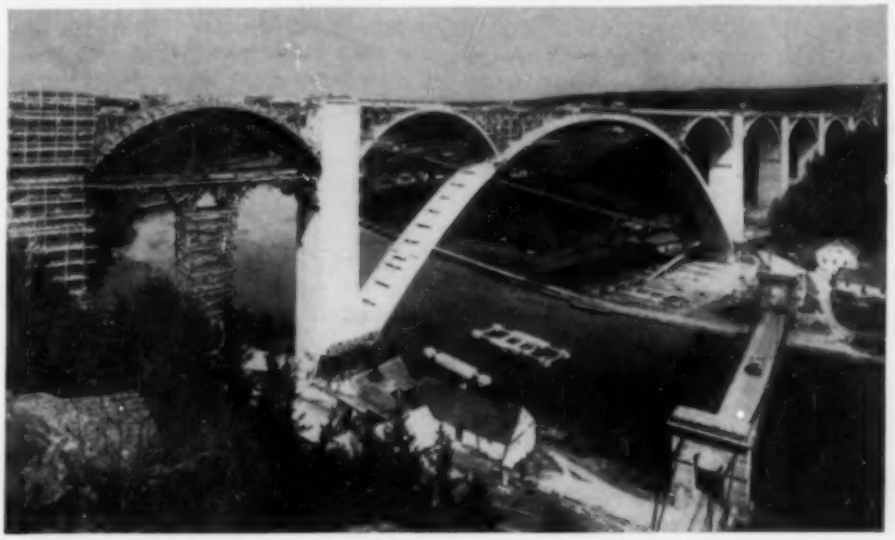
Because of these unfavorable temperature conditions, loading tests were made on the arch to eliminate any doubt as to its safety. The testing program included: (1) Determination of elastic deformation; (2) examination of the uniformity of the physical properties of the concrete in critical sections of the arch; and (3) corroboration of experimental data with calculated values.

Testing started on September 27, 1940. A load of 40 tons, uniformly distributed over the whole width of the arch, was applied at the support of the spandrel arch, on each side separately. The pressure was exerted by two hydraulic jacks installed in concrete barges floating in the river, with sufficient counterweight to eliminate lifting. Deflections were measured with Mahr and Zeiss deflectometers, with 1/1,000-mm accuracy. Strains in concrete were measured with Huggenberg extensometers to 1/10,000-mm accuracy.

All measurements were conducted under the supervision of Dr. B. Hacar, director of the Engineering Materials Laboratory, Technical University, Prague. Concrete samples 10 to 11 months old, taken during the pouring of the arch, gave compressive strengths varying from 4,800 to 6,100 psi. The average tensile

(*Continued on page 73*)

LEFT FLANKING ARCH has three-hinged steel-arch truss form in place, same truss form used for center section of main arch and other flanking arches. In recognition of outstanding achievement in bridge engineering, Podolsko Bridge was awarded Grand Prix at International Exposition in Liège, Belgium.



Engineers' Notebook

Good Field Notes Reflect Clear Thinking

G. A. RIEDESEL, Assoc. M. ASCE

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Moscow, Idaho

FIELD NOTES are the language of the field engineer. They are the medium through which all field information and data are relayed to the design or administering office. They must therefore be clear, definite, and complete. Good field notes reflect clear thinking and competent, well-organized field work. Unfortunately some notes reflect the mental condition described by Lincoln, when he said of one of his associates, "He is a bewildered, confounded, and miserably perplexed man." The same facts and rules for engineers' field notes apply equally well to research and investigation data of all kinds.

Organization and Arrangement

Generally any set of field notes can be organized as follows:

1. Title page. The title page, usually the first outside cover page or the first inside right-hand page of the set, should give the following information (Fig. 1):

a. Definite identification of the work—the name or number of the project.

b. Location—town, county, section.

c. Kind of work—profile levels, topographic or alignment notes.

d. Purpose of the survey.

e. Party members, or at least the chief of party.

f. Method and instruments used, etc.

g. Inclusive dates of the survey.

h. Other information of a general nature that applies to the whole set of notes.

2. Tabulation Pages. Left-hand pages throughout the set should be for tabulated data (Fig. 2).

3. "History" Pages. Right-hand pages throughout the set should be reserved for sketches and descriptive information if such information is included (Fig. 2). Descriptive information on the right-hand page should be kept opposite the appropriate tabulation referred to on the left-hand page. On the history page show party, date, and weather for each day's work.

4. Special Pages. Such special pages as an index page, calculation page, and others, should be included in a set whenever helpful.

Use of Standard Forms

For routine work, standardized forms have been developed and are in general use. They are the best for general purposes. Unless there is a good reason for changing, use the accepted form for the work you are doing. Such forms usually provide for all things needed. It should be noted, however, that accepted forms are not always adequate and sufficient. There is frequent omission of important data and details in many accepted forms.

Notes should not be crowded. It is good practice to have one or more blank lines between entries (for later notation or for calculations) in all tabulated data.

What to Include

As part of the observed and recorded information, the following should be included:

1. All direct data observed—the primary information that is to be used in the calculations, map or design.

2. All related data used in obtaining the observed data, such as:

a. In cross-section notes, the bench marks, rod readings, heights of instrument (HI's), etc.

b. In determining distances, by simple triangulation or slope measurements, the tape readings, angles, calculations, etc., should be shown so that all calculations and results obtained in the field can be checked in the office.

c. All transit points set, such as offset points, range points, etc., even though they are not a part of the desired center line, established transverse or layout.

d. The order in which the work was done and the procedure followed should be shown. If profile levels, cross sections, etc., are taken backwards on a line, as is often the case, even though they are recorded to read forwards, it should be indicated that they were taken backwards. Job and field conditions often justify unusual or unorthodox procedure and order, but they never justify deceitful recording.

3. Incidental details and observations should be included to the extent that time and the purpose of the work permits, even though at the time they may appear unimportant or superfluous. Such notations as the nature of the vegetation, kind of soil, velocity of stream flow, topographic features, etc., are often invaluable, even though to the notes

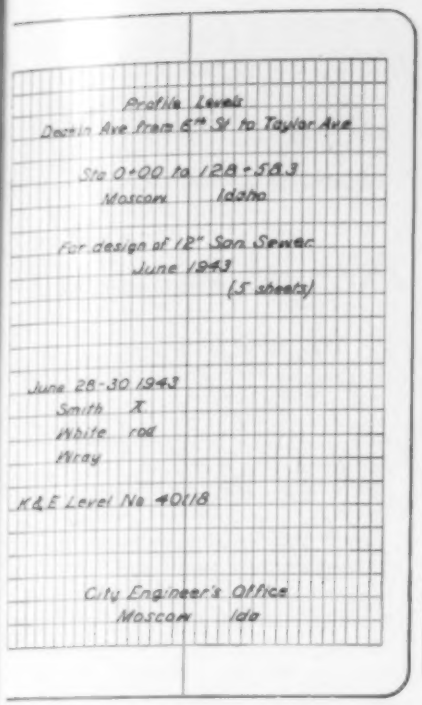


FIG. 1. TITLE PAGE, usually first outside cover page, should identify set of notes and give all general information as to time, place, purpose, personnel, method, and equipment used.

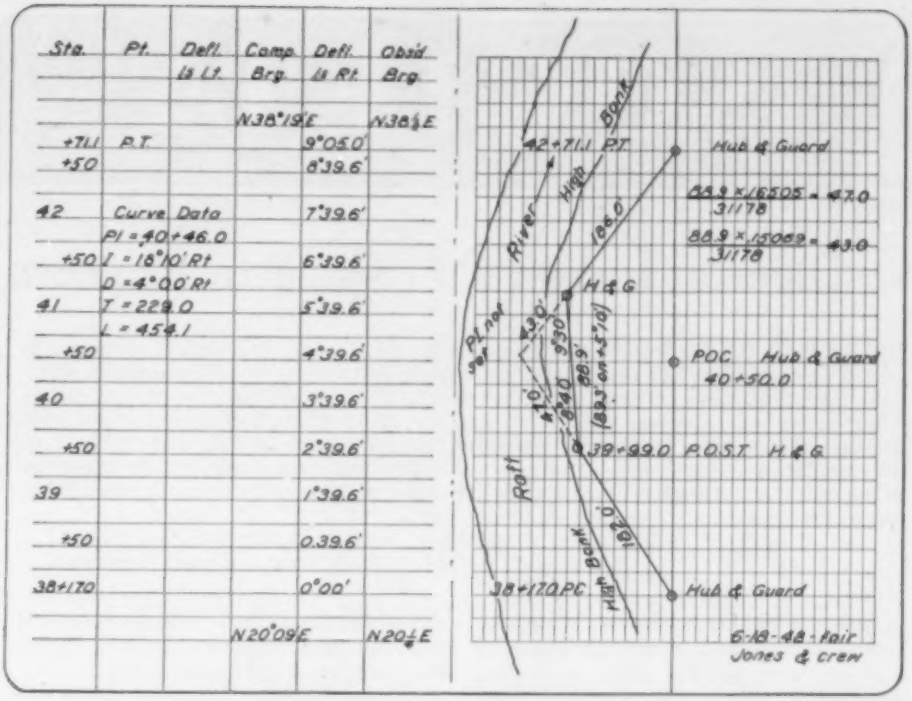


FIG. 2. TRANSIT NOTES for highway-curve location with inaccessible point of intersection should show all points set, all measurements taken, and all calculations. Note that using separate columns on left-hand page for deflection angles left and deflection angles right precludes possibility of recording any angle without designating whether it is to left or to right.

in which they are entered they may appear irrelevant.

4. Sketches. *Draw a picture.* A sketch will serve the purpose of showing more detail and layout than pages of description or tabulated data.

Mistakes and Omissions

Proper note keeping goes a long way toward eliminating mistakes and omissions. The notekeeper should scrutinize each entry, making a quick mental check and comparison with the previous entry, and with the measurement observed. The wrong algebraic sign before an angle or a rod reading will usually be detected by an alert recorder. All possible checks on field measurements and observations should be insisted upon. Field calculations should always be checked by a second member of the party. A rodman should always be required to keep a set of "peg notes" and thereby check the calculations for HI and elevations for the levelman. A head chainman should always check the transitman's calculation on curves, spirals, deflections, and bearings.

When angles are doubled for a check the doubled value should be recorded to show that the angle was doubled. Observed bearings should be recorded as a check on computed bearings. In traverse surveys the use of separate columns for deflection angles right and deflection angles left will avoid any mistakes as to the direction of the angle. The field work should be planned to provide checks and closures and such checks can usually best be foreseen in note keeping.

Mistakes made in recording are inexcusable. Entries should always be made at once, at the time and place of the work, never left to memory, never recorded on scraps of paper to be entered later. It is a good idea to make a temporary note of a dimension or distance, if the sketch or notes are not yet ready for the final entry. A temporary note in the margin is better than trying to remember, but the measurements and observations should not be permitted to get ahead of the recording.

Avoid Office Errors

Mistakes made in the interpretation and use of field notes are inexcusable. Field data should be so organized, recorded, and presented that there can be but one interpretation and that the correct one. A few minutes' time in the field putting in an extra explanation or detail may save hours of doing and undoing wrong work in the office. At the end of a day's work the notes should be so complete and up to date that another party could continue with the work if the original party should all be killed on the way home.

General Considerations

Notes should be so kept that they will be acceptable evidence in court—so that a jury can understand them and a lawyer can't dispute them.

When there is a break in the continuity of the work, proper cross references should in all cases refer to the subsequent data.

Equations in levels, distance, or bearing should always be clearly indicated and emphasized.

Loose-leaf notes should always be guarded against loss or misplacement. They should always be numbered and when possible an identification should be put on each sheet.

Copied notes should always be so marked and referenced to the original. Notes should never be destroyed. Even copied or voided notes should be carefully indexed and filed.

EDITOR'S NOTE: *The constructive suggestions that are set forth in this article will be of special interest to those who attended the Second National Surveying Teacher's Conference in 1940, sponsored by the Society for the Promotion of Engineering Education, as supplemental to the papers there presented, with particular regard to student instruction, on "The Technique of Notekeeping," by Paul P. Rice, Assoc. M. ASCE, Lafayette College, and Charles O. Roth, Jr., of Cooper Union.*

SOCIETY NEWS

Diverse Technical Program to Keynote Annual Meeting

THE ANNUAL MEETING COMMITTEE joins with the Headquarters staff in extending a cordial welcome to the 96th Annual Meeting of the Society in New York City. Despite rising costs, the Committee is happy to report that there will be no increase in the price of tickets to the various social functions and, in fact, some may be lower than last year. This has been made possible with the cooperation of the Hotel Commodore management and is based on the expectation that increased attendance will reduce unit costs of service. As usual, the ladies will find that special provision has been made for their entertainment and comfort during the meeting.

1949 Annual Meeting Committee
Edward J. Cleary, Chairman

A THREE-DAY PROGRAM of subjects of wide technical and professional concern has been arranged for the 96th Annual Meeting of the ASCE, to be held in New York City, January 19–21. Sharing the spotlight with the annual Wednesday morning business meeting, at which prizes and awards for the year will be presented, are 17 sessions of ten ASCE Technical Divisions.

Ten Technical Divisions to Meet

One or more sessions have been scheduled by the Structural, Highway, Surveying and Mapping, Construction, Soil Mechanics and Foundations, City Planning, Power, Air Transport, Waterways, and Sanitary Engineering Divisions. In addition, there will be joint sessions of the Sanitary Engineering Division with the New York State Sewage Works Association and the American Water Works Association on Friday. The Construction Division has scheduled sessions for Thursday morning and afternoon, and is sponsoring the Thursday luncheon, which will feature a number of brief talks on the outlook in various fields of construction. The speakers will include W. E. Reynolds, Commissioner of Public Buildings, Washington, D.C.; Charles B. Spencer, president of the New York engineering firm of Spencer, White & Prentis; Rear Admiral Kirby Smith, vice-president of the Raymond Concrete Pile Co., New York City; and Elmer K. Timby, chairman of the Princeton University department of civil engineering.

There will be a cooperative session of the United States Council of the International Association for Bridge and Structural Engineering on Friday; an inspection trip over the express highways in the Metropolitan area followed by a tour through the Johns-Manville plant and research laboratories at Manville, N.J., on Friday; and a Saturday inspection trip to the 26th Ward Sewage Treatment Works in Brooklyn.

Wallace K. Harrison, director of planning for the United Nations Headquarters will be the keynote speaker at the Wednesday membership luncheon. Other special events include the traditional Wednesday evening dinner dance and a smoker and entertainment for the men on Thursday evening. The annual Conference of Student Chapters in the Metropolitan area, featuring a symposium on job opportunities in civil engineering, will be addressed briefly by Franklin Thomas, newly elected President of ASCE.

College Reunions

To the list of colleges and engineering fraternities scheduling reunions, which were listed in the program in the December issue, should be added the Chi Epsilon luncheon on January 20; the Columbia University Department of Civil Engineering dinner at the Men's Faculty Club, 117th Street and Morningside Drive, on January 21; and the University of Illinois dinner on Thursday evening, January 20 (see box, page 50).

Elmer K. Timby

W. E. Reynolds

Kirby Smith

Charles B. Spencer

TALKS ON CONSTRUCTION SUBJECTS by experts in field will feature Thursday luncheon meeting. Scheduled speakers include Elmer K. Timby, member of executive committee of ASCE Construction Division and chairman of civil engineering department at Princeton University; W. E. Reynolds, since 1939 commissioner of public buildings, Washington, D.C., and authority on construction engineering economics; Rear Admiral Kirby Smith, chairman of executive committee of Construction Division, wartime director of construction for the Navy Bureau of Yards and Docks, and now vice-president of Raymond Concrete Pile Co.; and Charles B. Spencer, president of New York firm of Spencer, White & Prentis, Inc., and authority in field of heavy construction.

Society Prizes and Medals to Be Awarded

Twelve Engineers Will Be Honored at ASCE Annual Meeting for Notable Papers

SOCIETY PRIZES AND medals will be presented at the opening session of the ASCE Annual Meeting in New York City on January 19, 1949. The Norman Medal, which was established in 1872 by the late George H. Norman, M. ASCE, for an original paper considered an especially distinguished contribution to the profession, is the oldest and most notable of these awards. Considered next in point of distinction is the J. James R. Croes Medal, which was established in 1912 and named for the first recipient of the Norman Medal.

The late Thomas Fitch Rowland, Hon. M. ASCE, endowed the prize bearing his name in 1884. This award is given for a paper that best describes in detail some accomplished work of construction. In 1912 the Society established the James Laurie Prize, which was named in honor of the first President and goes to the paper considered second in merit to that awarded the Thomas Fitch Rowland Prize.

The Arthur M. Wellington Prize for the best paper dealing with some phase of transportation was established and endowed by the *Engineering News-Record* in 1921. Although the recipient of this award need not be a member of the Society, its award rests with the Society.

In 1894 the Collingwood Prize for Juniors was established by the late Francis Collingwood, M. ASCE, on his retirement as Secretary of the Society. Papers eligible for this award must describe an engineering work or record an important investigation with which the author has been connected. Excellence of style is also a governing factor in the selection of the paper receiving this award.

In a somewhat different category are the Division prizes, which also will be presented at the Annual Meeting. The oldest of these Division awards is the Rudolph Hering Medal, which was endowed in 1924 by the Sanitary Engineering Division of the Society, for the paper considered the most valuable contribution to the sanitary branch of the profession.

The J. C. Stevens Award, established in 1943, is given annually to the Society member submitting the best paper in the field of hydraulics, published in TRANSACTIONS. This award, which is made on the recommendation of the Hydraulics Division, consists of books costing not more than $50, to be selected by the recipient.

In 1939 A. P. Greensfelder, Hon. M. ASCE, endowed the Construction Engineering Prize. Although this prize is awarded on advice of the Construction Division, it is different from the other Division prizes in that it is the only award specifically limited to material appearing in CIVIL ENGINEERING.

Established in 1947 and administered by the Structural Division, the Leon S Moisseiff Award is being given for the first time this year. This award, consisting of a bronze medal and a certificate signed by the President and the Executive Secretary of the Society, is endowed by two memorial committees, in recognition of the professional accomplishments of the late Leon S. Moisseiff, M. ASCE. The award is to be given annually to the author of an important paper in the current volume of TRANSACTIONS, dealing with the broad subject of structural analysis.

Biographical sketches of those receiving prizes or medals follow.

ALFRED M. FREUDENTHAL

THE NORMAN MEDAL goes to Alfred M. Freudenthal, engineering educator and consultant, for his paper on "The Safety of Structures." On leave from the Hebrew Institute of Technology in Haifa, Palestine, Dr. Freudenthal is at present a practicing engineer in New York City and a special lecturer and research consultant to several American universities.

Born in Poland, Dr. Freudenthal graduated from the Technische Hochschule in Prague in 1929, and obtained the degree of doctor of science in engineering in 1930. In the same year he completed the full curriculum in theoretical physics at Charles University, Prague. From 1930 to 1936 he worked as design engineer and superintendent of construction on various projects in Czechoslovakia, Poland, and Palestine; and from 1936 to 1944 he served, first, as head of the design office and, later, as resident engineer on the construction of the Port of Tel Aviv, Palestine. During the war he was consultant to the chief engineer of the British Forces in Palestine and Transjordan and directed the construction in Tel Aviv of motor-minesweepers for the British Navy. In 1945 he opened an office as consulting engineer in Tel Aviv.

Since 1937 Dr. Freudenthal has also been associated with the Hebrew Institute of Technology, at present in the capacity of professor of civil engineering on leave of absence. Early in 1947, he came to the United States to visit university and industrial laboratories in connection with a research project on fatigue of metals sponsored by the Hebrew Institute and the British Research Fund. Joining the faculty of the University of Illinois in the fall of 1947, in the capacity of visiting professor, he took part in the extensive fatigue research program sponsored by the Office of Naval Research and taught a course on the inelastic behavior of materials in the Graduate School.

In the fall of 1948, Dr. Freudenthal moved to New York where he is engaged in civil engineering practice—with Jacob Feld, M. ASCE, of the consulting firm of Feld & Timoney—and as research consultant, specializing in problems of engineering materials. He is also lecturer and research consultant for the University of Illinois and special lecturer at Columbia University.

Author of a number of articles in technical and scientific journals in this country and Europe and of a monograph on *Composite Columns*, Dr. Freudenthal has presented papers at many international congresses. In 1937 he was awarded a prize in a competition for design of a new bridge over the Vistula at Warsaw, and in 1946 he won second prize in the textbook competition of the J. F. Lincoln Arc Welding Foundation for a manuscript on "Principles of Design of Steel Bridges." His textbook on *Inelastic Behavior of Materials and Structures* is in the course of preparation and will be published by J. Wiley & Sons Inc., in 1949.

Dr. Freudenthal joined the ASCE as Associate Member in 1937, and has been a full member since 1947. His other affiliations include the American Society of Mechanical Engineers, the Institute of Aeronautical Sciences, the American Institute of Physics, the American Society for Testing Materials, the American Statistical Association, the Illinois Chapter of Sigma Xi, and a number of European and Palestinian technical societies.

KARL DE VRIES

LONG INTERESTED IN the application of the theory of mechanics, especially in beam and column problems, Karl de Vries is the recipient of the J. James R. Croes Medal for his paper, "Strength of Beams

ALFRED M. FREUDENTHAL
Norman Medal for Paper, "The Safety of Structures"

HYDE FORBES
James Laurie Prize for Paper, "Landslide Investigation and Correction"

JOSEPH BARNETT
Arthur M. Wellington Prize for "Express Highway Planning in Metropolitan Areas"

KARL DE VRIES
J. James R. Croes Medal for "Strength of Beams as Determined by Lateral Buckling"

M. M. FITZHUGH

J. S. MILLER

KARL TERZAGHI

Thomas Fitch Rowland Prize for Paper, "Shipways with Cellular Walls on a Marl Foundation"

JOHN K. VENNARD
Collingwood Prize for Juniors for "Nature of Cavitation"

C. GLENN CAPPEL
Construction Engineering Prize for Paper, "Steel H-Piles and Pipe Bents Support Deep Water Drilling Platform"

C. E. JACOB
Rudolph Hering Medal for Paper, "Drawdown Test to Determine Effective Radius of Artesian Well"

PRESTON T. BENNETT
J. C. Stevens Award for Paper, "Relief Wells for Dams and Levees"

GEORGE WINTER
Leon S. Moisseiff Award for Paper, "Strength of Thin Steel Compression Flanges"

as Determined by Lateral Buckling," which is the result of one of his studies.

Born in Germany, Mr. de Vries graduated from the University of Darmstadt in 1921. He spent the following two years with a large steel fabricator in Duesseldorf, Germany, on the design of bridges and mill buildings, and a similar period in structural design for a general contractor in Mexico City. From 1926 to 1928 he worked for the American Metal Co. in Monterrey, Mexico, on a great variety of structures, including a power plant and pump station.

Since 1928, Mr. de Vries has been in the Bridge Design Department of the Fabricated Steel Construction Division of the Bethlehem Steel Co., Bethlehem, Pa. His work there has included design, erection computations, and investigation in general of all types of bridges and steel structures.

A member of the ASCE since 1935, Mr. de Vries is active on the Structural Division's Committee on Applied Mechanics, and serves on its Subcommittee on Torsional Properties of Structural Members and Torsional Instability. He also belongs to the Subcommittee on Torsional Instability of the Committee on Research of the Column Research Council.

M. M. FITZHUGH

CO-RECIPIENT OF THE Thomas Fitch Rowland Prize for a paper on, "Shipways with Cellular Walls on a Marl Foundation," M. M. FitzHugh is plant engineer for the Newport News Shipbuilding and Dry Dock Co.

Mr. FitzHugh was born in Culpeper County, Virginia, and graduated from the Carnegie Institute of Technology School of Applied Industries, class of 1910. He attended the University of Virginia in 1914 and 1915, taking special work in engineering and economics.

Upon leaving the University in 1915, he was employed by the Newport News Shipbuilding and Dry Dock Co. to install a cost system in its foundries. In 1917, Mr. FitzHugh was transferred to the newly organized Plant Engineering Division of the company, where he worked in various engineering capacities. Since June 1924 he has been plant engineer. His experience in plant engineering during World War I and later was of inestimable benefit in preparing him for the responsibilities he had to assume in World War II.

As plant engineer for the Newport News Shipbuilding & Dry Dock Co. during World War II, Mr. FitzHugh was directly responsible for the design and construction of the submerged shipways which are the subject of his prize-winning paper. In addition, he was responsible for the original layout of the Wilmington, N.C., plant of the North Carolina Shipbuilding Co., and he served as consultant during the construction, equipment, and expansion of the plant as the Maritime Commission's need for shipbuilding facilities increased during the war emergency.

JAMES S. MILLER

JAMES S. MILLER, co-winner of the Thomas Fitch Rowland Prize, is senior vice-president and director of the Dravo Corp., Pittsburgh, Pa. Educated in public schools and by private tutor, Mr. Miller attended West Virginia University. Many years later he received the honorary degree of doctor of engineering from Lehigh University.

In 1906, after ten years' experience in the engineering and construction departments of the Bessemer & Lake Erie Railroad, Mr. Miller became connected with the Dravo Corp. During his early years with Dravo, he superintended the construction of a great variety of work, including bridge substructures on Cape Cod, Mass., and in Chicago, Ill., and Steubenville and Sciotoville, Ohio; locks and dams in the Black Warrior River in Alabama and in the Allegheny, Monongahela, and Mahoning rivers; and important mill structures in the Pittsburgh and Youngstown areas, and at Sparrows Point, Md.

In 1921 Mr. Miller assumed the duties of planning and directing the general construction work of the Dravo Contracting Co., which he later served as vice-president, director, and president. He has been senior vice-president and director of the Dravo Corp. since 1936, and until June 1945 was also general manager of the Contracting Division of the organization.

During the period since 1921, Mr. Miller has directed the construction of notable bridges over the Schuylkill, Delaware, Allegheny, Monongahela, Ohio, Kanawha, Mississippi, and Wabash rivers and his firm's participation in the construction of the San Francisco-Oakland Bay Bridge. The long list of important locks and dams constructed under his general direction includes the largest roller gate dam in the United States at Gallipolis, Ohio, and Bluestone Dam, just completed at Hinton, W.Va.

Mr. Miller's affiliations include the Duquesne Club, the Engineers Society of Western Pennsylvania, and the Consulting Constructors Council of America. He is also a past-president and former member of the Board of Governors and one of the principal founders of the Constructors Association of Western Pennsylvania. Mr. Miller has been granted a number of patents dealing with construction equipment and methods.

KARL TERZAGHI

EMINENT IN BOTH the teaching and consulting fields is Karl Terzaghi, co-winner of the Thomas Fitch Rowland Prize. At present he is professor of the practice of civil engineering in the Harvard University Graduate School of Engineering.

Born in Prague, Czechoslovakia, Dr. Terzaghi graduated from the Technische Hochschule at Graz, Austria, in 1904. From 1905 to 1914 he was employed in various capacities, chiefly as superintendent of construction on jobs in Austria, the Balkans, northern Russia, and the western part of the United States. He then served for two years in the air corps of the Austrian Army.

In 1916 Dr. Terzaghi became professor of civil engineering at the Imperial Engineering School at Istanbul, Turkey, remaining until 1918 when he accepted a similar position at Robert College (an American institution) in Istanbul. He was at Robert College until 1925, engaging in extensive experimental research on foundations, the results of which were published in 1925 in a book entitled *Erdbaumechanik*. From 1925 to 1929 he continued his teaching activities at the Massachusetts Institute of Technology, serving also during this period as a consultant on various dam, foundation and subway projects.

Dr. Terzaghi accepted a professorship at the Technische Hochschule in Vienna in 1929 and remained there until 1938. During these years he was a consultant on Swir III, a hydroelectric power development in northern Russia; on irrigation projects in Central Asia and Transcaucasia; on the construction of rockfill dams in Algiers; and on numerous other projects in the Eastern hemisphere.

Harvard University invited Dr. Terzaghi to lecture on soil mechanics in 1936, the year of its tercentenary celebration. The First International Conference on Soil Mechanics met at Harvard in that year, and Dr. Terzaghi served as its president. Resigning his professorship in Vienna in 1938, he returned to the United States and was appointed lecturer in the Harvard Graduate School of Engineering.

From 1938 to 1941 Dr. Terzaghi acted as consultant on soil mechanics in connection with the building of the Chicago subway. In 1941 he was employed by the Dravo Corp., of Pittsburgh, on the construction of two drydocks at Newport News, Va. During the past few years he has served as consultant on numerous construction jobs in the United States,

Mexico, Canada, and Sweden. In 1946 he went to India as a member of a board of consultants for a large reclamation project, and during the following two years he has served in a consulting capacity in Brazil, British Columbia, and Alaska. Since 1947 Dr. Terzaghi has occupied one of the newly established chairs of professor of the practice of civil engineering in the Harvard Graduate School of Engineering, and he is also lecturer and research consultant in civil engineering at the University of Illinois.

In June 1948, he acted as president of the Second International Conference on Soil Mechanics and Foundation Engineering in Rotterdam, Holland, and as a general reporter at the Third International Congress on Large Dams in Stockholm. At present he is connected in a consulting capacity with the Garrison Dam Project and investigation of the subsidence of the Long Beach area in California and various other projects.

Dr. Terzaghi is the author of *Theoretical Soil Mechanics* and co-author of *Soil Mechanics in Engineering Practice*, *Rock Tunneling with Steel Supports*, and various other books. Contributor of numerous papers to the ASCE PROCEEDINGS, he was awarded the Norman Medal of the Society in 1930, 1943, and 1946.

His membership in the ASCE dates back to 1925 when he became an Associate Member. He has been a full member since 1927, and in 1948 was elected Honorary Member. Dr. Terzaghi's other technical affiliations include the Institution of Civil Engineers, which he served as James Forrest Lecturer for 1939, and the Boston Society of Civil Engineers. He has won the Desmond FitzGerald Medal and the Herschel Prize of the latter organization and the Frank P. Brown Medal of the Franklin Institute, Philadelphia. He is also an honorary member of the Austrian Society of Engineers and Architects, and in 1948 he received the golden medal of honor of this society.

HYDE FORBES

AN AUTHORITY IN the broad field of engineering geology, Hyde Forbes receives the James Laurie Prize for a paper on "Landslide Investigation and Correction." In private practice in California since 1921, Mr. Forbes now has a consulting office at Palo Alto.

Mr. Forbes was born in Chicago and educated at Stanford University, receiving an A.B. degree in geology and mining engineering in 1913. Following his graduation, he was employed on the investigation of geology and groundwater conditions for various agencies, municipalities, and water companies in California. This work included a four-year period (1917 to 1921) in charge of field investigations for the Lindsay-Strathmore Irrigation District in litigation involving the irrigation use of water.

During Mr. Forbes' long career in private practice he has made investigations and reported on soil foundations for buildings in San Francisco and for the Sacramento Water Department; on soil technology and mechanics for the San Francisco Section of the Society, Stanford University, and the California-Hawaiian Sugar Co.; and on tunnels in connection with tunneling for the East Bay Utility District, City of Los Angeles, the Western Pacific Railroad, and the El Dorado Irrigation District. He has also advised on development of water supplies through wells, springs, and tunneling throughout the State of California, for many municipalities and private companies, and on drainage of land for municipal and airport development.

Since 1941 Mr. Forbes has devoted considerable time to work for the San Francisco Department of Public Works, and the San Francisco Water Department, his projects including six landslide corrections, two tunnels, land stabilization, reservoir seepage correction, slope retention, six foundation investigations, two earthfill construction projects, and the determination of active faults in relation to the location of the new Hetch Hetchy pipeline to the San Andreas Reservoir and from there to the Lake Merced pump station in San Francisco. During this period he has also acted as consulting engineer and geologist for the City of Palo Alto on expansion of its water supply; for the City of Napa on the construction of an earthfill dam and reservoirs; and for the City of Vallejo on development of a groundwater supply.

In addition, Mr. Forbes has also been employed on suburban developments in the San Francisco Bay counties, landslide investigations for the Public Utilities of California and the State Veterans' Bureau, and groundwater investigations in Southern California. Other important engagements include slope stabilization in an excavated hill area of the San Francisco Naval Shipyard for the Navy Department, in 1947, and the Toketee Project of the California-Oregon Power Co., in 1948. He is currently at work on earthfill construction for the Alameda County Water District.

During the war Mr. Forbes held an architect-engineer contract for water supply development for Fort Ord and for the atomic bomb plant at Hanford, Wash., and its operating village at Richland, Wash.

Joining the ASCE as a Junior in 1916, Mr. Forbes became Associate Member in 1920 and Member in 1937. He has written numerous papers on underground water development and foundation investigations for the TRANSACTIONS of the Society, *Western Construction News*, *Engineering News-Record*, *Modern Irrigation*, and other publications.

IN ADDITION TO the colleges scheduling reunions for Annual Meeting week, which were listed in the program in the December issue, should be added the Columbia University Department of Civil Engineering dinner at the Men's Faculty Club, 117th Street and Morningside Drive, on January 21, at 6 p.m. (the charge of $3.50 will be collected at the dinner); the Chi Epsilon luncheon on January 20; and the University of Illinois dinner on January 21. Detailed information about the two latter events may be obtained from Harold Larsen at Society Headquarters.

JOSEPH BARNETT

JOSEPH BARNETT, RECIPIENT of the Arthur M. Wellington Prize for his paper, "Express Highway Planning for Metropolitan Areas," is chief of the Urban Road Division of the Public Roads Administration. In this capacity he is entrusted with the review of all federal-aid programs of urban highway projects. Since 1941, when the Defense Highway Act provided federal funds for advance engineering studies and preparation of plans, including those for arterial routes in cities, he has been advising state highway departments, counties, and cities in their study of traffic problems.

Graduating from the Cooper Union Institute of Technology (day) in 1916, with the degree of bachelor of science in civil engineering, Mr. Barnett received his C.E. degree from the same institution in 1927. Between 1916 and 1925 he was an engineer on the design and construction of buildings, bridges, and other structures for several engineering concerns, except for a period of service in World War I as ensign, USNRF, with engineering duties. In 1925 he joined the staff of the Westchester County Park Commission, New York, and for the next eight years assisted in the pioneer development of parkways and expressways, which established a pattern for such facilities in metropolitan areas.

Mr. Barnett has been with the Public Roads Administration since late in 1933. After a year in charge of surveys and design for the George Washington Memorial Parkway along the Potomac north of Washington, he investigated all known information on highway design and pre-

pared data for use nationally by state highway departments. The importance of this work was recognized by the formation of the Committee on Planning and Design Policies of the American Association of State Highway Officials, which Mr. Barnett has served as secretary since its inception. He was in charge of the detailed design of the relocation of the Mount Vernon Memorial Highway and of the access roads and parking areas of the Washington National Airport.

Later Mr. Barnett was placed in charge of the design of the vast network of roads and bridges, necessitated by construction of the Pentagon Building, just outside Washington, D.C. This project was carried out in cooperation with the War Department, which was in charge of the construction of the building and its service roads and parking areas. Mr. Barnett also directed the design of the Henry G. Shirley Memorial Highway as far south as Fairfax County, Virginia.

A member of the ASCE since 1926, Mr. Barnett is Society representative on the Highway Traffic Standards Committee of the American Standards Association and alternate on the Interprofessional Urban Planning Committee. He also holds membership in the District of Columbia Society of Professional Engineers, the Department of Design of the Highway Research Board, and the Road Design Committee of the American Association of State Highway Officials. Mr. Barnett is the author of *Transition Curves for Highways*, and has published several articles on highway engineering in ASCE and other publications and has lectured extensively to post-graduate, professional, and nonprofessional groups.

JOHN K. VENNARD

JOHN K. VENNARD, winner of the Collingwood Prize for Juniors for his paper "The Nature of Cavitation," is associate professor of fluid mechanics at Stanford University.

Professor Vennard received his bachelor's degree in 1930 and a master's degree in 1932 from Massachusetts Institute of Technology, where he specialized in the water power option of the civil engineering course. As research assistant at M.I.T. from 1932 to 1935, he worked on cavitation problems under visiting Prof. Wilhelm Spannhake. He became instructor in fluid mechanics at New York University in 1935, assistant professor in 1939, and associate professor in 1945. While at New York University, Professor Vennard developed undergraduate and graduate courses in the fluid mechanics field, built up the laboratory facilities, and devoted himself to many research projects.

His industrial experience consists of a year with Goodyear Zeppelin as a structural designer and two summers at Pratt and Whitney Aircraft on supercharger research. He joined the faculty at Stanford University in 1946. Professor Vennard is the author of *Elementary Fluid Mechanics*, which was published in 1940, with a second edition in 1947.

Joining the ASCE as a Junior in 1936, Professor Vennard became an Associate Member in 1944. His other professional affiliations include membership in Tau Beta Pi, Sigma Xi, and Chi Epsilon.

CHARLES EDWARD JACOB

GROUNDWATER HYDRAULICS HAS been the dominant interest of Charles Edward Jacob, recipient of the Rudolf Hering Medal, for a paper on "Drawdown Test to Determine Effective Radius of Artesian Well." Mr. Jacob is head of the Department of Geophysics at the University of Utah.

Born in Phoenix, Ariz., Mr. Jacob was educated in the public schools of Salt Lake City and received the B.S. degree in civil engineering from the University of Utah in June 1935. The following year he studied hydraulics under Boris Bakhmeteff, Hon. M. ASCE, and Hunter Rouse, M. ASCE, at Columbia University, receiving the M.S. degree in June 1936. From 1942 to 1944 Mr. Jacob was a research associate at the same institution while continuing his graduate work.

In July 1936 Mr. Jacob began work with the Ground Water Division of the Water Resources Branch of the U.S. Geological Survey. During the next eight years he was engaged in groundwater investigations in New York, New England, Pennsylvania, Illinois, Texas, and Florida. In 1944 he was transferred to the Washington office, where he became chief of the Section of Ground Water Hydraulics. This assignment took him to every part of the country for technical review of investigations.

After eleven years of service, Mr. Jacob left the Geological Survey in July 1947 to become associate professor and head of the Department of Geophysics in the College of Mines and Mineral Industries at the University of Utah. At present he is giving instruction in groundwater hydrology as well as in other branches of geophysical science. He is the author of several technical papers on groundwater and related subjects.

Mr. Jacob joined the ASCE as an Associate Member in 1942. He is also a fellow of the Geological Society of America, a member of the American Geophysical Union, and an associate of the Highway Research Board. Other professional affiliations include membership in the honorary societies, Tau Beta Pi and Sigma Pi Sigma. He is chairman of a committee on permeability, under joint sponsorship of the American Geophysical Union and the Geological Society of America, with representation from 20 technical societies. His interest in fluid-permeation has led him into a closely related field, petroleum reservoir engineering, and he has served as consultant on problems relating to underground water supply and recovery of petroleum.

PRESTON T. BENNETT

PRESTON T. BENNETT, winner of the J. C. Stevens Award, is employed by the Corps of Engineers, Omaha District, where he is in charge of the foundations, materials, and specifications groups in the Design Branch.

Beginning his work for the Corps of Engineers in the Kansas City District in 1930, Mr. Bennett transferred to the Missouri River Division when it was organized in 1934. As assistant to the soils engineer of the Division, he participated in foundation investigations and embankment design for numerous flood-control projects in the Missouri River basin. These projects included construction of levees at Topeka and Kansas City, investigations of the failure of Marshall Creek Dam and its reconstruction, building of Kanopolis Dam on the Smoky Hill River, and investigation of the slide at Fort Peck Dam.

In 1942 Mr. Bennett was designated head of the Airfield and Embankment Design Section of the Missouri River Division. In this capacity, he supervised a staff of engineers on the design and construction of numerous airfields for heavy aircraft, roads and streets for cantonments, and other military construction projects.

Returning to civil projects near the end of the war, Mr. Bennett worked closely with soils engineers of the various Engineer Districts in the design of earthfill dams for several of the initial projects included in the "Pick Plan" for the development of the Missouri River basin. Included in these projects were the Cherry Creek Dam near Denver, the Harlan County Dam on the Republican River, earth dams and channel improvements for flood control at Hot Springs, S.Dak., pressure relief wells for Fort Peck Dam, and preliminary investigations for a proposed system of pressure relief wells for levees at Kansas City.

With the beginning of intensive planning and initial construction on a system

of major multiple-purpose dams on the Missouri River, Mr. Bennett was transferred to the Omaha District as head of the Soils and Foundation Section. In this assignment, he directed subsurface investigations, laboratory studies, and preliminary embankment design for Garrison, Oahe, and Fort Randall Dams, and for an extensive system of levees along the Missouri River. His discussion of T. A. Middlebrooks' paper on relief wells reflects his particular interest in the control of underseepage, one of the major problems of embankment design.

Mr. Bennett has been a member of the ASCE since 1946.

C. GLENN CAPPEL

FOR THE SECOND time, ASCE Director C. Glenn Cappel, member of the firm of W. Horace Williams Co., engineers and contractors of New Orleans, La., has been awarded the Construction Engineering Prize. He was previously honored in 1945.

A native of Louisiana, Mr. Cappel was graduated from Louisiana State University in 1912, with the degree of B.S. in C.E. Subsequently, he studied structural design at Rensselaer Polytechnic Institute. After several years as bridge engineer for the Louisiana Highway Department, he was engaged on the structural design of large buildings for the architectural firm of Favrot & Livaudais. In 1920 he went to Mexico for Doullut & Williams, Inc., as assistant manager and chief engineer on a multimillion-dollar oil terminal. Upon the dissolution of Doullut & Williams, Inc., he became a vice-president of W. Horace Williams Co., Inc., the predecessor of the present partnership.

Mr. Cappel's experience includes the design and construction of highway bridges, wharves, foundations, terminals, and other structures. In 1926 Mr. Cappel, as representative of his company, was engaged by the Louisiana Highway Commission, in cooperation with Dr. William H. Burr, New York City consultant, to investigate and report on construction of bridges and approaches over the outlets of Lake Pontchartrain, Chef Menteur, and Rigolets. In 1935 he devised a method and designed the structures for moving a five-story reinforced concrete building in the City of New Orleans, where difficult foundation conditions prevail.

A pioneer in the field of steel wharf design, Mr. Cappel has designed and his firm has built these structures in the lower Mississippi River, the Gulf Coast Area, and Trinidad, B.W.I., during the past ten years. In addition to designing new structures, he has devised ways of rehabilitating old wharves, giving them added useful life.

During the past year Mr. Cappel has been active in the design and construction of platforms in the Gulf of Mexico, where oil companies are exploring the continental shelf for new oil fields. In World War II, he was in charge of the construction of several major Army and Navy projects for his company.

A full ASCE member since 1924, Mr. Cappel is now serving as Director from District 15. He is a past-president of the Louisiana Section of the Society, and a past-president and life member of the Louisiana Engineering Society.

As vice-chairman of the Mayor's Housing Committee, Mr. Cappel was chairman of a committee to revise the Building Code of the City of New Orleans.

GEORGE WINTER

AUTHOR OF NUMEROUS papers describing original research in the fields of engineering structures and applied mechanics, and a frequent contributor to technical discussions in the publications of the Society and elsewhere, George Winter is the first recipient of the Leon S. Moisseiff Award for his paper on "Strength of Thin Steel Compressive Flanges." A paper supplementing and extending his prize-winning paper was presented at the Third Congress of the International Association for Bridge and Structural Engineering, in Liege, Belgium, in September 1948.

A native of Vienna, Austria, Professor Winter obtained his engineering education at the Institutes of Technology of Vienna, Stuttgart and Munich, where he received the degree of Dipl. Ing. in civil engineering in 1930. During the succeeding eight years, the last six of which he spent in Russia as a foreign consultant, Professor Winter specialized in structural design, primarily of large industrial plants.

Professor Winter came to this country in 1938 as a research investigator at Cornell University, where he received the degree of Ph.D. in 1940. Going through the usual academic ranks at Cornell, he was appointed to head the department of structural engineering early in 1948. His educational approach lays special stress on a basic approach to fundamental concepts and methods in structural analysis, in contrast to "handbook engineering."

Continuously since going to Cornell University, Dr. Winter has conducted structural research there. Among other programs he is in charge of a long-range research project on the use of light gage, cold-formed steel in building construction, sponsored by the American Iron and Steel Institute. This work resulted in the Specifications for the Design of Light Gage Steel Structural Members, issued by the Institute in 1946, which subsequently have been incorporated in the building codes of numerous municipalities.

Dr. Winter is active on a number of research committees, including the ASCE Committees on Applied Mechanics and on Masonry and Reinforced Concrete, and is chairman of one of the subcommittees of the latter committee. He is also a member of various committees of the Column Research Council and co-chairman of one of its subcommittees.

In addition to his membership in the Society, which he joined in 1944, he is also a member of the American Concrete Institute, the International Association for Bridge and Structural Engineering, Sigma Xi, Tau Beta Pi, Chi Epsilon, and Phi Kappa Phi.

Five Engineers Elected to Honorary Membership

CHARLES H. BUFORD

AN AUTHORITY IN the field of railroad operation and railroad engineering economics, Charles H. Buford has risen through the ranks to the presidency of the Chicago, Milwaukee, St. Paul & Pacific Railroad Co., with which he has spent most of his working years.

Born in Newport, Ark., Mr. Buford remained a resident of that state until 1907, when he was graduated from the University of Arkansas, with a civil engineering degree. He went directly from school to a job with the Milwaukee Road at Ottumwa, Iowa, as a $75-a-month instrumentman. After holding a similar position in the Kansas City Division, he was promoted to draftsman in the bridge department in Chicago. In 1910 he went to the Atchison, Topeka & Santa Fe as a designing and estimating engineer in the office of the chief engineer at Topeka, Kans., but by April 1913 he was back with the Milwaukee Road as assistant engineer on track elevation. Later he was promoted to engineer of track elevation.

It was in April 1917 that Mr. Buford made the transfer from the engineering to the operating department, assuming the duties of trainmaster of what was then the Sioux City and Dakota Division. He held a similar position in the La Crosse Division, and later was promoted

to superintendent of the Wisconsin Valley Division. He became general superintendent of the railroad's Southern District, with headquarters in Chicago, in October 1924, and in November 1925, he was advanced to assistant general manager of Lines East. He became general manager, Lines West, with headquarters in Seattle, on November 1, 1927, and served in that capacity until October 1, 1939, when he was elected vice-president

CHARLES H. BUFORD
New Honorary Member

of the Association of American Railroads in charge of operations and maintenance, with headquarters in Washington, D. C.

Among Mr. Buford's wartime assignments with the Association of American Railroads were the staffing of a military transportation section of the A.A.R. to assist the armed forces in their movement of troops and materiel; establishment of a tight control of port-bound traffic in coordination with the Office of Defense Transportation; the appointment of a port traffic manager for the A.A.R; negotiations with the armed forces and the Reconstruction Finance Corporation to provide special troop-carrying and troop kitchen cars for wartime use; and the establishment of administrative channels for the operation of special movements for the armed forces.

In his position as vice-president of the A.A.R. in charge of operations and maintenance, Mr. Buford was the central figure in the railroad industry to whom the military planners looked for professional guidance in the overwhelming transportation problem they faced. The War Department was in constant contact with him in matters affecting the movement of troops and supplies and in the general planning of transportation for the prosecution of the war. The successful unification of the American railroads, under his leadership, has been recognized as one of the great factors in the early termination of the war.

Outstanding among the accomplishments of the military transportation section of the A.A.R., under Mr. Buford's jurisdiction, was the diversion and reconsignment of thousands of port-bound cars following the announcements of V-E and V-J days. He also had to cope with the postwar transportation problems brought about by the shortage of freight cars. On May 17, 1946, when the country faced a nationwide railroad strike, the railroads were seized by the federal government, and Mr. Buford was appointed federal manager.

Returning to the Milwaukee Road as executive vice-president on March 1, 1946, Mr. Buford was elected to the presidency of the railroad and to a seat on its board of directors on May 13, 1947.

The many distinctions conferred upon Mr. Buford include the President's Certificate of Merit, awarded for his services in the field of transportation during the war; the Certificate of Appreciation of the Bureau of Naval Personnel of the U.S. Navy for the material assistance given toward the solution of problems involved in the transportation of seven million persons in the United States during the war; a Certificate of Appreciation from the War Department for patriotic services in a position of trust and responsibility; and the Citation of Distinguished Alumnus of the University of Arkansas. He has, also, been given honorary membership in the American Railway Bridge & Building Association, and is a founder member of the American Society of Traffic and Transportation and a member of the board of trustees of the Illinois Institute of Technology.

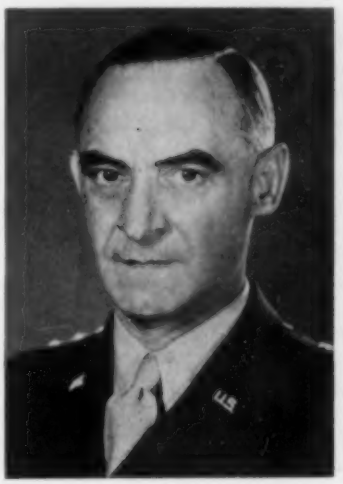
Mr. Buford has been a corporate member of the ASCE since 1917.

LUCIUS D. CLAY

LUCIUS D. CLAY, military governor of the United States zone in Germany and commander-in-chief of American Forces in Europe, has achieved wide fame as military engineer and administrator.

A native of Marietta, Ga., and alumnus of the U.S. Military Academy at West Point, General Clay has devoted his entire career to service in the Army Corps of Engineers. Following his graduation in 1918, he served as an instructor at the Officers' Training Camp at Camp Humphrey, Va. Later that year he was assigned to the Engineer School at that post, graduating from the Civil Engineer Course in June 1920. Teaching assignments at Alabama Polytechnic Institute, Camp Humphreys, and the U.S. Military Academy filled much of the next decade. Completing a tour of duty at Fort Humphreys, Va., in 1930, he was graduated from the Company Officers' Course of the Engineer School and assigned to Corozal, C.Z., for duty with the 11th Engineers.

Transferred to the Office of the District Engineer at Pittsburgh, Pa., in 1931, Captain Clay supervised the construction of Lock and Dam No. 2 on the Allegheny River. From 1933 to 1937 he was in Washington, D.C., where he became head



GEN. LUCIUS D. CLAY
New Honorary Member

of the River and Harbor Section of the Office of the Chief of Engineers. During this period Captain Clay served as United States delegate to the Permanent International Congress of Navigation. As representative of the Corps of Engineers, he also played an active part in formulating the public works program of that period.

In October 1937, Captain Clay was transferred to the Philippine Islands as adviser on engineering projects and a survey of water power facilities. Appointed district engineer at Denison, Tex., in August 1938, he was in charge of the construction of Denison Dam and Red River Dam. In October 1940 he became secretary of the Airport Board and assistant to the Administrator of Civil Aeronautics and had charge of the first National Airport Program.

Early in the war, General Clay was assigned to Headquarters, Services of Supply (later redesignated Army Service Forces), in Washington, as Deputy Chief of Staff for Requirements and Resources. In July 1942 be became Assistant Chief of Staff for Materiel, Headquarters Army Service Forces in Washington, in which capacity he served on the Production Executive Committee of the War Production Board. Later his title was changed to Director of Materiel at the same headquarters. In November 1944, he was placed in command of the Nor-

mandy Base Section, European Theater of Operations, where he was in charge of the port of Cherbourg.

General Clay's next assignment took him to the Office of War Mobilization and Reconversion in Washington, where he served as deputy to War Mobilizer James F. Byrnes until April 1945. He then went overseas as deputy to General Eisenhower to take charge of civil affairs under the arrangement agreed upon for the occupation of Germany. His official title on that assignment was deputy military governor and United States representative on the Coordinating Committee for Germany.

In January 1947 General Clay succeeded Gen. Joseph T. McNarney as military governor of the United States Zone in Germany and as commanding general of the U.S. Forces of Occupation in Germany and U.S. Forces in Europe. The latter title was changed to commander-in-chief, European Command, in March 1947.

Promoted through the various Army grades, General Clay received the temporary rank of full general on March 28, 1947. He now has the permanent rank of major general.

His many decorations include the Distinguished Service Medal, which went to him in April 1945, "for exceptionally meritorious and distinguished service in the performance of duties of great responsibility as Director of Materiel, Army Service Forces, from March 1942 to October 1944." The citation concludes, "The great foresight, unusual initiative, brilliant and inspiring leadership and complete devotion to duty demonstrated by General Clay in the execution of outstanding accomplishments have contributed immeasurably to the successful prosecution of the war." In the same month, he was awarded the Legion of Merit "for exceptionally meritorious conduct in the performance of outstanding service while in charge of the Civil Airport Program of the United States from October 1, 1940, to December 16, 1941."

General Clay is also holder of the Bronze Star Medal and the foreign decorations of Knight Commander (Honorary) Order of the British Empire from the United Kingdom; the Order of Kutuzov, first class from the Soviet Union; the White Lion and Distinguished Service Medal of Czechoslovakia; the Order of Oak Leaf Crown from Luxembourg; and the French Legion of Honor. His nonmilitary awards include the honorary degree of doctor of laws from the University of Louisville.

General Clay has been a full member of the ASCE since 1939, and also holds membership in the Society of American Military Engineers and the permanent International Navigation Congress.

DONALD DERICKSON

WELL KNOWN IN the field of engineering education, Prof. Donald Derickson retired in 1946 as professor of civil engineering and head of the Civil Engineering School at Tulane University, New Orleans, La.

Born in Meadville, Pa., Professor Derickson was educated at the Allegheny College preparatory school and at Allegheny College, where he completed his sophomore year. He spent the next two years with the U.S. Coast and Geodetic Survey on the mapping of the upper reaches of the Chesapeake Bay, and as a topographic draftsman in the Washington office. He then entered the Thayer School of Civil Engineering of Dartmouth

DONALD DERICKSON
New Honorary Member

College, graduating in 1902 with the degree of civil engineer. Later he received the honorary degree of doctor of science from Allegheny College. While at the Thayer School, he formed a lifelong friendship with the director, the late Robert Fletcher, M. ASCE, which was instrumental in shaping his career as an educator.

Immediately following his graduation, Professor Derickson entered the employ of the Berlin Construction Co., spending two years as superintendent on the construction of industrial buildings and bridges. He resigned from this position to serve as an instructor in civil engineering at Pennsylvania State College for the next year and a half. From 1905 to 1912 he was on the Cornell University faculty —for two years as instructor in bridge design and five years as assistant professor in the department of bridge and structural engineering. Summer employment during this period included work in Alaska with the Alaskan Boundary Survey and on the impact tests conducted by the American Railway Engineering and Maintenance of Way Association (now the AREA).

In 1912 Professor Derickson was invited to go to Tulane University, where he remained as head of the School of Civil Engineering until his retirement in 1946. During this period he also engaged in the practice of his profession—for three years in association with the late J. F. Coleman, Past-President ASCE. He served in a consulting capacity on the construction of difficult foundations, bridges, buildings, sea walls, river and harbor works and miscellaneous structures, including the 82,000-seat Tulane Stadium. He has acted as arbitrator in disputes growing out of engineering contracts, and his services have been retained in matters relating to litigation.

Professor Derickson was employed in 1918 by the New Orleans Public Belt Railroad Commission as special assistant engineer to a board investigating the feasibility of a bridge or tunnel crossing of the Mississippi River at New Orleans. In addition to other civic services, he was a member of the board appointed to prepare a building code for the City of New Orleans, and chairman of the committee concerned with the structural engineering features of the project. This work resulted in adoption of the building Code of 1922, which was in effect for many years.

In 1936 Professor Derickson developed a plan for, and recommended to the Louisiana Engineering Society, a soil and foundation survey of New Orleans and its vicinity. Carried out as a relief project with federal funds, the survey gave employment to engineers, draftsmen, and others during a period when it was hard to find employment. The results of the survey appeared in an extensive publication, entitled *Some Data in Regard to Foundations in New Orleans and Vicinity*, which was so well received that the Louisiana State Department of Public Works published an addendum to it. As chairman of the committee charged with directing the project, Professor Derickson gave much of his time to the work.

Elected as Associate Member of the ASCE in 1914 and a Member in 1916, Professor Derickson served as president of the Louisiana Section in 1923 and as Faculty Adviser of the Tulane University Student Chapter from 1934 until his retirement. His recommendations on Juniors, made in a report presented while he was chairman of an early Committee on Juniors, were adopted by the Society.

Professor Derickson is a past-president and honorary member of the Louisiana Engineering Society, and president of the Louisiana State Board of Engineering Examiners, having served continuously on the Board since 1917. From 1936 to 1944, he was prominently identified with the activities of the Engineers Council for Professional Development, in the accrediting of engineering courses in the educational institutions in the zone of

operations to which he was assigned as a representative of the ASCE and of the National Council of State Boards of Engineering Examiners. Professor Derickson's other affiliations include membership of the Technical Advisory Board and the Committee on Structural Research of the American Institute of Steel Construction, Tau Beta Pi, and the Society of Sigma Xi.

GANO DUNN

EMINENT AS AN engineer, educator and industrialist, Gano Dunn has been president of The J. G. White Engineering Corp. for many years. Since 1935 he has also been president of Cooper Union for the Advancement of Science and Art.

A native New Yorker, Mr. Dunn was graduated from the City College in 1889 with the degree of bachelor of science, and from Columbia University in 1891

GANO DUNN
New Honorary Member

with the degree of electrical engineer. He has since received honorary degrees of doctor of science from Columbia, Rutgers, New York University, and City College; the degree of doctor of engineering from Lehigh University; and the degree of doctor of laws from Bowdoin College.

He worked his way through college as a night telegraph operator in the employ of the Western Union Telegraph Co., and from 1898 to 1911 was vice-president and chief engineer of the Crocker-Wheeler Electrical Manufacturing Co. During his service with that organization, he took out numerous patents for the design and construction of electrical machinery.

Joining the staff of J. G. White & Co. in 1911, Mr. Dunn in 1913 was made president of the J. G. White Engineering Corp., which position he now holds. This engineering firm specializes in the design and construction of hydraulic and steam power plants in the field of public utilities and private industry, and in the design and construction of chemical, oil, and many other types of manufacturing plants in the United States and foreign countries. It constructed the U. S. Naval Oil Base at Pearl Harbor, the Lake Ontario Ordnance Works for the manufacture of TNT, three large irrigation dams for the Republic of Mexico and manufacturing plants in Syracuse for the production of marine turbines and radar equipment.

The firm also built the U.S. government airport on the Island of Fernando do Noronha off the coast of Brazil, the Naval Ordnance Plant in Louisville, Ky., and numerous other projects. A four-year public works program of roads, bridges and irrigation works was conducted for the Republic of Haiti, and following this work Mr. Dunn was decorated with the Order of Honor and Merit of the Republic of Haiti.

Mr. Dunn was instrumental in the organization of the Engineering Foundation, established by Ambrose Swasey, Hon. M. ASCE, and was its first chairman; and for three years was president of the United Engineering Trustees. He is a past-president and honorary member of the American Institute of Electrical Engineers; an honorary member of the American Society of Mechanical Engineers; a fellow of the Institute of Radio Engineers; overseas representative in the United States of the Institution of Electrical Engineers of Great Britain; and a fellow of the Royal Microscopical Society of London. He is a vice-chairman of the World Power Conference, and chairman of its Executive Committee for the United States.

From 1923 to 1928 Mr. Dunn was chairman of the National Research Council of the National Academy of Sciences, of which he is a member. Among the honors that have been accorded him are the Edison Medal for 1937 for "distinguished contributions in extending the science and art of electrical engineering, in the administration of great engineering works and for inspiring leadership in the profession." In 1939 he received the Hoover Medal, "Awarded by engineers to a fellow engineer for distinguished public service"; and in the same year the Egleston Medal of Columbia University. He has also been awarded the Townsend Harris Medal of the City College, the Modern Pioneer Award of the National Association of Manufacturers and the Gold Insignia of the Pan American Society of which he is an honorary president.

Mr. Dunn has been active in many fields of public service—national, state and city—and has been United States delegate to several international engineering congresses. During World War I he was chairman of a special committee of the State War and Navy Departments on Submarine Cables, and a member of the Nitrate Commission of the War Department. Prior to World War II, President Roosevelt appointed him a member of The President's Committee on Civil Service Improvement; and in World War II he served as senior consultant in the Office of Production Management, where he was appointed by President Roosevelt to investigate and report on the capacity of the steel industry for national defense. He was for a number of years chairman of the Visiting Committee of the National Bureau of Standards, and is now a graduate member of the Business Advisory Council for the Department of Commerce.

In New York State activities, Mr. Dunn has recently served as a member of Governor Dewey's Temporary Commission on the Need of a State University, and a member of his Technological Advisory Committee.

In New York City activities, he was a member of Mayor LaGuardia's Business Advisory Committee, and a consultant to the New York City Housing Authority. During Mayor O'Dwyer's administration, he was one of three engineers appointed by the City Planning Commission to make a survey and prepare a report on "Selected Measures for the Partial Relief of Traffic Congestion in New York City." At present Mr. Dunn is serving as one of the advisers to the Public Works Task Force of the Hoover Commission on Organization of the Executive Branch of the Government, under the chairmanship of Robert Moses.

ANDREW WEISS

IRRIGATION AND THE development of irrigation projects has been the predominant interest of Andrew Weiss. At present he is chief of the Technical Consulting Department of the Ministry of Hydraulic Resources in Mexico City, Mexico.

Mr. Weiss obtained his technical training in the Colorado School of Mines, where he graduated with the degree of engineer of mines in June 1899. In September of the same year, following summer employment as assayer in the Bimetallic Smelter at Leadville, Colo., Mr. Weiss was called back to the School of Mines as assistant professor in mathematics and surveying, and he continued in that position until June 1903.

With the passage of the Reclamation Act of June 17, 1902, a large field opened for the employment of irrigation engineers, and Mr. Weiss entered the U.S. Reclamation Service (now the Bureau of Reclamation) as assistant engineer in

June 1903. The months from June to December 1903 were spent on topographic surveys on the North Platte Project in Wyoming, and from January to July 1904 on reconnaissance surveys on the Salt River Project in Arizona. Mr. Weiss then returned to the North Platte Project to direct the location and construction of the first division of the Interstate Canal until June 1907, when he was promoted to project manager of the North Platte Project. In the latter position he supervised the construction and development of the Interstate Unit, which later was enlarged by the addition of the Fort Laramie Unit, comprising a total irrigable area of some 255,000 acres.

At the close of 1924, Mr. Weiss was promoted to Assistant Director of Reclamation Economics. In this capacity he rendered valuable service as member of a Board of Adjustments in the application of the terms of the so-called Fact Finder Act, which Congress passed following the Recommendation of the Fact Finder Commission in 1924. The objective of the work of the Board of Adjustment was to outline the application of the Benefits of the Act of Congress to the various irrigation systems then in operation.

In January 1926, following passage by the Mexican Congress of a reclamation law modeled after the United States Reclamation Act of June 1902, the J. G. White Engineering Corp., of New York, was employed to locate, plan, and construct irrigation projects in that country under the supervision of the National Irrigation Commission of Mexico. Mr. Weiss then joined the J. G. White Corp. to take engineering charge of the building of the Don Martin Irrigation System, including a storage dam on the Salado River. In April 1930, his duties were extended to include technical supervision of the building of the Conchos Project in the State of Chihuahua.

ANDREW WEISS
New Honorary Member

In September 1932, when the J. G. White Engineering Corp. closed its Mexican work, the National Irrigation Commission of Mexico invited Mr. Weiss to come to Mexico City as consulting engineer on all projects then under construction and in the course of study. He was advanced to the position of chief of the Technical Consulting Division in the construction of reclamation and drainage works in July 1938. Since then the activities of the National Irrigation Commission of Mexico have been greatly enlarged and are still in the course of expansion. To date it has built some 30 irrigation projects, complete with storage dams in full operation; and some 18 additional storage dams, including the necessary distribution and drainage works, are in the course of construction. The Commission has also been responsible for the construction of numerous small projects, generally in cooperation with the States.

With the development of dam construction in Mexico, the sites available for location of concrete and masonry dams have become relatively scarce, calling for increased use of earth or rockfill dams and of the combination earth and rockfill type. Mr. Weiss has made a valuable contribution to this field of construction by introduction of a method of passing flood waters in bypasses or over earth- and rockfill dams under construction, where conditions make such a course either necessary or of striking economic advantage.

Mr. Weiss has been a member of the ASCE for 40 years, and a full member since 1917. His other affiliations include the American Society of Agricultural Engineers, the American Concrete Institute, and the Association of the Engineers and Architects of Mexico.

ASCE Studies Engineering Classification for Government of Puerto Rico

AT THE REQUEST of Dr. Manuel A. Perez, Director of Personnel for the government of Puerto Rico, and with the approval of the Puerto Rico Local Section and the ASCE Board of Direction, an appraisal of the classification and allocation of all engineering positions classified by the Insular Office of Personnel has been undertaken by a representative of the Society headquarters staff. This study is substantially like the one performed in 1946 under similar circumstances for the Louisiana State Director of Personnel, and is the ninth survey of engineering classifications made under the Society's auspices since 1940.

In the government of Puerto Rico, the Office of Personnel functions as a civil service for such insular agencies as may be assigned to it. At the present moment, 14 of these agencies employ engineering personnel ranging from draftsmen and engineering aides up through division and bureau heads. Currently 795 engineering and closely allied positions in these agencies are classified by the Office of Personnel. For example, the Department of the Interior, with 456 engineering and architectural employees, contains a Bureau of Public Works with six technical divisions in specialized fields.

A year and a half ago a comprehensive and satisfactory classification plan was installed by the Public Administration Service of Chicago. In the 18 months of operation under this plan certain questions have arisen as to its application, which led the Director to seek a testing and maintenance study of the adequacy of engineering classifications and allocations. It is not expected that the basic plan will be disturbed.

Allen P. Richmond, Jr., of the Society headquarters staff, who has performed similar studies under Society auspices, was assigned to the project as an adviser to the Director of Personnel regarding engineering and allied positions only. Mr. Richmond was in San Juan from November 15 to December 4 and will return again for as many other short visits as may be necessary to complete the study. Most of the detailed work will be performed by members of the Classification Division of the Office of Personnel under the guidance of Mr. Richmond, who will evaluate all data collected and will be responsible for the final report.

Engineering Index Volumes Are Wanted

REQUESTS FOR BOUND volumes of *Engineering Index*, covering the period from 1928 to the present, have been received from various libraries and organizations here and abroad. Engineers having copies they do not need are asked to get in touch with Ralph H. Phelps, director of the Engineering Societies Library, 29 West 39th Street, New York 18, N.Y.

Joint Orientation Conference on National Military Establishment

The Conference Objectives and Composition

R. E. DOUGHERTY, PRESIDENT, ASCE

"THE NATIONAL MILITARY Establishment is conducting a series of Joint Orientation Conferences for leaders in the industrial, labor and professional fields. The first conference will be held during the period November 8 to 18, 1948.

"The purpose of this conference is to acquaint the group with current activities and problems of the Military Establishment and to obtain the views of the members on matters concerning national defense."

So began a letter dated September 14, 1948, from Secretary of Defense James V. Forrestal to the President of the American Society of Civil Engineers. As a result of this invitation and others like it, about eighty men attended the conference which opened at the Pentagon in Washington, D.C., on November 8. A list of those in attendance at the Pentagon meetings is appended, as is also a summary of the program.

After the Pentagon meetings, from November 8 to 12, inclusive, which were very well attended, about fifty-five of the group went on the field trips. These fifty-five were first flown from Washington to Pensacola, Fla., for demonstrations aboard naval aircraft carriers and submarines; then by air to Fort Benning, Ga., for demonstrations by the Army; and then to Eglin Air Force Base, Fla. The Conference closed at Eglin Field on November 18.

There were many phases of the Conference which are of tremendous interest and import to the members of ASCE and to every citizen. Although all subjects on the program were presented and discussed with amazing frankness, many of these were "classified" material and not open for publication at this time.

It was impossible for me to attend all sessions, and it was readily arranged with the Secretary of Defense for Vice-President Carlton Proctor, who also is the contact Board member for our Committee on Military Affairs, to attend so that either, or both of us, could be present at every session of the Conference. We both attended nearly all the meetings of the Conference at the Pentagon, and Mr. Proctor continued on to Pensacola, Ft. Benning and Eglin Field. He will supplement, with details and conclusions, my brief statement outlining the background of the Conference.

All of us who were fortunate enough to be participants in this unusual and nationally significant Conference were tremendously impressed by the sincerity, frankness and competence of the Secretary of Defense and all the other governmental officials who appeared. The collective consensus of opinion was summarized by the following resolution at the conclusion of the Washington, D.C., part of the conference on November 12:

"After attendance at Orientation Conferences at the Pentagon Building, November 8th to 12th, inclusive, during which time we have received detailed information as to the organization of the Department of Defense, the accomplishments of unification of services, and the program and plans for completion of unification be it resolved that:

"We, the members of the Conference, hereby express our confidence that the accomplishments to date in creating the new Department of Defense are soundly conceived and soundly founded; our gratitude as citizens for the genius of judgment and administration, exercised in creating our new Defense Organization, unprecedented as to size, importance and complexity; our anxious hope for the early completion of the task of unification, so vital to the defense of our country and the security of all free peoples, at the same time continuing to apply experience tests to each basis reorganization decision, and our respect, admiration, and complete confidence in the responsible director of these vital accomplishments, the Secretary of Defense."

Conferees at Pentagon Building

WINTHROP ALDRICH
Chairman of the Board, Chase National Bank
VALLEE O. APPEL
President, Fulton Market Cold Storage Co.
THOMAS P. ARCHER
Vice-President, General Motors Corp.
EDWIN G. BARRINGER
Executive Vice-President, Institute of Scrap Iron and Steel, Inc.
EDMUND R. BECKWITH
Chairman, Committee on Legal Aspects of Security, American Bar Association
JAMES F. BELL
Chairman of the Board, General Mills, Inc.
CHARLES D. BENNETT
Special Consultant, Foundation for American Agriculture
JOHN D. BERG
Chief Executive Officer, Dravo Corp.
EDWARD L. BORTZ
Past-President, American Medical Association
FLETCHER T. BOWRON
Mayor of Los Angeles, Calif.
GEORGE H. BUCHER
Vice-Chairman of the Board, Westinghouse Electric Corp.
OLIVER E. BUCKLEY
President, Bell Telephone Laboratories
ALBERT C. BUEHLER
President, Victor Adding Machine Co.
JAMES B. CAREY
Secretary-Treasurer, Congress of Industrial Organizations
WILLIAM L. CHENERY
Publisher, *Collier's Magazine*
DUNLAP C. CLARK
Chairman, Committee on National Defense, Chamber of Commerce of the United States
JOHN L. COLLYER
President, The B. F. Goodrich Co.
CHARLES R. COX
President, Carnegie Illinois Steel Corp.
C. COBURN DARLING
Director, AVCO
HENRY DARLINGTON
Rector, Church of the Heavenly Rest
HARVEY N. DAVIS
President, Stevens Institute of Technology
HAROLD S. DIEHL
Dean of the Medical Sciences, University of Minnesota
JOSEPH M. DODGE
Past-President, American Bankers Association
RICHARD E. DOUGHERTY
President, American Society of Civil Engineers; Vice-President, New York Central System
ALBERT B. DRAKE
President, Lehigh Warehouse and Transportation Co.
THOMAS DREVER
President, American Steel Foundries
DEWITT EMERY
President, National Small Businessmen's Association
EUGENE B. ENGLISH
Caterpillar Tractor Co.
RODGER J. EMMERT
General Motors Corp.
THOMAS F. FARRELL
Chairman, New York City Housing Authority

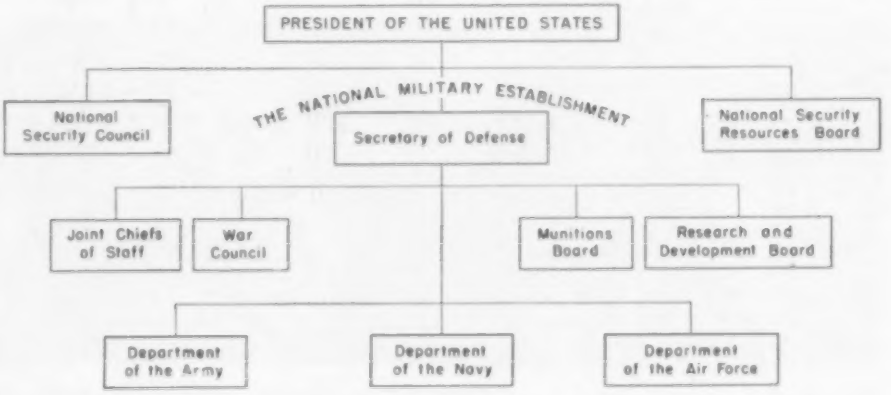


FIG. 1. UNIFICATION OF ARMED FORCES provides organization for national security.

JOHN M. FRANKLIN
President, United States Lines Co.
VOLMER W. FRIES
Vice-President, The White Motor Co.
GEORGE A. HAWKINS
Acting Dean of the Graduate School, Purdue University
ALBERT J. HAYES
Vice-President, International Association of Machinists
HENRY H. HENLINE
Secretary, American Institute of Electrical Engineers
CLARENCE E. HILL
Chairman of the Board, Northwestern National Bank of Minneapolis
LEWIS HINES
Legislative Representative, American Federation of Labor
PHILIP V. K. HOWAT
President, Howat Concrete Co.
AUSTIN S. IGLEHEART
President, General Foods Corps.
ERNEST E. IRONS
President-Elect, American Medical Association
BYRON V. KANALEY
Cooper-Kanaley and Co.
WILLIAM J. KELLY
President, Machinery & Allied Products Institute
GEORGE KILLION
President, American President Lines, Ltd.
EDWARD E. KLEIN
Rabbi, Free Synagogue
DAVID LAWRENCE
President, U. S. News and World Report
JOHN L. LEWIS
President, United Mine Workers of America
HOWARD H. LONG
Dean, College of Education and Industrial Arts (Ohio)
HENRY LOOMIS
Massachusetts Institute of Technology
RICHARD K. MELLON
T. Mellon and Sons
GEORGE W. MERCK
President, Merck and Co., Inc.
C. HART MILLER
Vice-President, The Glenn L. Martin Co.
JOSEPH N. MOODY
Professor of History, Cathedral College
ALBERT V. MOORE
President, Moore-McCormack Lines, Inc.
MALCOLM MUIR
President, *Newsweek*
JOHN H. MURPHY
Vice-President, University of Notre Dame
WILLIAM I. NICHOLS
Editor, *This Week Magazine*
DANIEL A. POLING
President, International Society of Christian Endeavor and of the World's Christian Endeavor Union
CARLTON PROCTOR
Vice-President, American Society of Civil Engineers
ALFRED N. RICHARDS
President, National Academy of Sciences
GEORGE A. RICHTER
Eastman Kodak Co.
NELSON A. ROCKEFELLER
Chairman of the Board, Rockefeller Center, Inc.
JACOB P. RUDIN
Rabbi, Temple Beth-El
RAY SAWYER
Chairman, Peace and Preparedness Committee, AMVETS
MARCUS W. SAXMAN, JR.
President, Latrobe Electric Steel Co.
ROSCOE L. SENSENICH
President, American Medical Association
AURA E. SEVERINGHAUS
Associate Dean, Columbia University College of Physicians and Surgeons
H. GERRISH SMITH
President, Shipbuilders Council of America
IRVIN STEWART
President, West Virginia University
WALKER STONE
Editor, Scripps-Howard Newspaper Alliance
ARTHUR H. SULZBERGER
Publisher, *The New York Times*
DAVIDSON TAYLOR
Vice-President, Columbia Broadcasting System
EDWIN. J. THOMAS
President, The Goodyear Tire and Rubber Co.
JULIUS A. THOMAS
Director, Industrial Relations, National Urban League
CHARLES H. THOMPSON
Dean of the Graduate School, Howard University
FRED A. VIRKUS
Chairman, Conference of American Small Business Organizations
ALEXANDER F. WHITNEY
President, Brotherhood of Railroad Trainmen
EDWARD L. WILLIAMS
President, Insurance Executives Association
IRVING W. WILSON
Vice-President, Aluminum Co. of America
J. CARLTON WARD, JR.
Chairman of the Board, Fairchild Engine and Airplane Corp.
JAMES L. WALSH
President, American Ordnance Association
ROBERT R. YOUNG
Chairman of the Board, Chesapeake and Ohio Railroad

Conference Staff

COL. B. M. MCFADYEN, Director
LT. COL. A. N. TYSON, Army Representative
COMMANDER J. P. FLOYD, Navy Representative
LT. COL. E. C. HARDIN, JR., Air Force Representative

Conference Details and Conclusions

CARLTON S. PROCTOR, Vice-President, ASCE

THE PENTAGON PART of the Conference finished in the afternoon of November 12, after which the field trip contingent of 55 were flown to Pensacola, and quartered aboard an aircraft carrier as guests of the Navy. An all-day cruise on the Gulf of Mexico was devoted to observation of Naval air operations: carrier landings, aircraft catapult, and anti-aircraft firing and refueling of a destroyer under way. Observations of operations aboard a submarine included the experience of diving and surfacing. Evening addresses were made to the group by officers of the Pensacola Base; by Donald Carpenter, Chairman of the Munitions Board; and by Admiral Louis E. Denfeld, Chief of Naval Operations.

Demonstration of new infantry weapons and training methods came before the Conference at Ft. Benning. At Eglin Field, on the last day, November 18, Air Force demonstrated jet-propelled aviation and airplane gunnery and torpedo practice. Of particular interest to the engineers present was the climatic hangar (250 ft × 200 ft × 60 ft) used for low-temperature experiments. Here at minus 65 deg F, equipment, machines, clothing and other military materials are being developed and tested for arctic warfare.

Each civilian member of this Joint Orientation Conference and Tour was left free to draw his individual conclusions as to the importance and significance of what he had heard and seen. Efforts by several of the conferees to obtain a definite answer to the question of "how we may collectively and individually assist in the strengthening of our military establishment," invariably brought the reply that the answer must rest with our own individual decisions. What follows, therefore, are my own observations and conclusions.

The principal objectives of the Conference and Tour were for the following purposes. First, the importance to our national security of a unified military establishment was demonstrated clearly. The

CONFERENCE GROUP aboard ship at Pensacola, Fla., consists of visitors from all parts of country. Members of group are leaders in science, engineering, business, industry, labor, local government, finance, law, medicine, church, education, and agriculture.

accomplishments to date, and the large amount of earnest endeavor and cooperative effort going into its day-to-day work were shown. All Americans can and should be proud of the carefully developed advances and development that our new teamwork of the three branches of the military, science, engineering, and industrial leadership is producing. There was much encouraging evidence that the fruits of the present policy will be an actual unification with a resulting high morale, and with that degree of flexibility necessary for a readiness to meet a national emergency.

Second, the vital importance to our national security of a continuing public support for an integrated and far reaching defense program was made clear. In no segment of our democratic history have we, the people of this country, shown such vacillation as in our support, and lack of support, of military expenditures. No peoples will support an all-out preparedness program as will we in times of national emergency. In times of prosperity, we will support just about any expenditure; but with the first indication of an economic recession, unless war is imminent, the military is the first to suffer by cut-back appropriations, so that no comprehensive, long-term plan has had any assurance of continued financial backing.

However, military preparedness cannot be effectuated on a year-to-year basis. Developments of this year are contingent on expenditures of next year, else much of this year's investment may be wasted. The vital need for a continuing, integrated program of military scientific advancement is inescapable. Such military preparedness is the cheapest and most intelligent form of national defense.

Third, it is clear that Russia is diverting about 70 percent of her national production to her military establishment. While her basic strategy is to attain world supremacy through fifth-column sabotage activities, she maintains the world's largest peacetime standing army and will take as full advantage of our military weaknesses as she has and will of our weaknesses in security, our social unrest, a reduction in our living standard, and any concrete evidence that we will refuse to use all of our force and united influence, if necessary, to resist her continued subjugation of distressed peoples.

The world situation compels our anticipation of the possibility of war, but need not create a national fear, so long as we maintain military supremacy. A "Pearl Harbor" that would inaugurate a Russian war would lead to consequences too horrible to imagine. Our strongest and most effective preventive of war will be in our possession of a strong, thoroughly integrated, military establishment.

Fourth, the ultimate national military establishment, as envisaged at the Orientation Conference and Tour, can be accomplished only with the continuing full cooperation of all segments of our body politic. All elements of our society whose moral and material support are essential to our national defense must be knit together and must be continuingly united.

Finally, if the American people are told the story as we learned it, there can be no doubt as to the rededication of our national determination for a united support of our preparedness program. Business and industry would then lend eager cooperative support, without question of profit or taxes. As it did during the stress of war, labor would put national security ahead of any other consideration; we would then become so strong, so soon, that the present threat of war would disappear.

Pentagon Program

Welcoming Address
JAMES FORRESTAL, Secretary of Defense.

"The National Security Council"
SIDNEY W. SOUERS, Executive Secretary, National Security Council.

"Organization of the National Military Establishment"
W. J. MCNEIL, Special Assistant to the Secretary of Defense.

"Estimate of the International Situation"
GEORGE F. KENNAN, Director, Policy Planning Staff, Department of State.

"Military Implications of the World Situation"
ADMIRAL H. R. HILLENKOETTER, Director, Central Intelligence Agency. Supplemented by MESSRS. MCMILLAN, WRIGHT, and HARVEY.

"Joint Chiefs of Staff and Joint Planning"
MAJ. GEN. ALFRED M. GRUENTHER, Director, The Joint Staff.

"Planning the Coordination of Military, Industrial, and Civilian Mobilization"
ARTHUR M. HILL, Chairman, National Security Resources Board.
R. E. GILLMOR, Vice-Chairman, National Security Resources Board.
Assisted by the staff, in cooperation with the staff of the Munitions Board, in presenting:

"Organization of NSRB and Its Relations with Other Departments and Agencies"
WILLIAM A. GILL

"Balancing Requirements with Resources"
RALPH J. WATKINS

"Planning the Mobilization of Power and Production from Raw Materials to Finished Product"
GEORGE E. FELTON

"Economic Management Including Stabilization Monetary Policies and Taxation, Rationing, Price, and Wage Control"
E. T. GRETHER

"Manpower Mobilization"
JAMES C. O'BRIEN

"Strategic Dispersion of Industry and Other Essential Facilities"
FRED E. HENDERSON

"Duties of the Munitions Board"
DONALD F. CARPENTER, Chairman, the Munitions Board.

"Military Aspects of Industrial Mobilization Planning"
LT. GEN. LEROY LUTES, Director of the staff, Munitions Board.
Assisted by the staff, in cooperation with the staff of the National Security Resources Board, in presenting:

"Allocation of Production Capacity"
MAJ. GEN. PATRICK W. TIMBERLAKE, Air Force

"Stockpiling of Strategic and Critical Materials"
MAJ. GEN. SIDNEY P. SPALDING, Army

"Procurement Procedures and Plans"
REAR ADMIRAL FRANCIS C. DENEBRINK, Navy

"Industrial Manpower Requirements"
CAPT. WILLIAM J. MARSHALL, Navy

"Economic Implications of Military Preparedness"
Dr. EDWIN G. NOURSE, Chairman, Council of Economic Advisors, Executive Office of the President.

"Military Preparedness and the National Budget"
JAMES E. WEBB, Director of the Bureau of the Budget, Executive Office of the President.

"Scientific Research and National Security"
Dr. VANNEVAR BUSH, Past-Chairman, Research and Development Board.
Assisted by the staff in presenting:

"Development of New Weapons"
DR. L. R. HOFSTAD, Executive Secretary

"Integration of Military Research Programs"
DR. ROBERT F. RINEHART

Utilization of Nation's Scientific Resources"
DR. R. V. BOWERS

"Atomic Energy"
DR. R. H. O'BRYAN

"Civil Defense"
RUSSELL J. HOPLEY, Director, Civil Defense Planning.

Special address
BRIG. GEN. LANHAM

"Progress in Unification"
John H. Ohly, Special Assistant to the Secretary of Defense.

"Report on E.C.A. and the Marshall Plan"
PAUL HOFFMAN, Administrator, Economic Cooperative Administration

"The Army"
KENNETH C. ROYALL, Secretary of the Army.
Gen. OMAR N. BRADLEY, Chief of Staff, U.S. Army.

"The Navy"
JOHN L. SULLIVAN, Secretary of the Navy.
ADMIRAL LOUIS E. DENFELD, Chief of Naval Operations, U.S. Navy.

"The Air Force"
W. STUART SYMINGTON, Secretary of the Air Force.
GEN. HOYT S. VANDENBERG, Chief of Staff, U.S. Air Force.

R. J. Kennedy Awarded J. Waldo Smith Prize

THE FIRST POSTWAR award of the J. Waldo Smith Hydraulic Fellowship goes to Russell J. Kennedy, of the Iowa Institute of Hydraulic Research, who will do research on the hydraulics of side-channel weirs at the University of Iowa during the 1948–1949 school year.

A Canadian by birth, Mr. Kennedy graduated from Queen's University at Kingston, Ontario, in 1941, with the bachelor of science degree in civil engineering. He was graduated with honors and received the departmental medal in civil engineering. While at the university he did summer work with the Hydroelectric Power Commission of Ontario. From 1941 until 1946 Mr. Kennedy served as a lieutenant with the Royal Canadian Engineers, receiving the Military Cross for service in Holland. From 1946 to 1948, he was a lecturer in the civil engineering department of Queen's University. In September 1948, following summer employment as assistant to the chief hydraulic engineer of the Ontario Paper Co., he joined the staff of the University of Iowa Institute of Hydraulic Research.

R. J. Kennedy

Established by the ASCE Board of Direction in 1938, the J. Waldo Smith Fellowship was endowed by a bequest to the Society of the late J. Waldo Smith, Hon. M. ASCE. The fellowship, which currently carries a cash award of $1,000 plus an allowance of $400 for equipment, emphasizes practical research in the field of experimental hydraulics rather than purely theoretical hydraulics.

Reinstatements and Resignations Listed

AS AN ECONOMY MEASURE, the ASCE Board of Direction decided, at its October meeting, to discontinue publication of membership additions and transfers in CIVIL ENGINEERING. Reinstatements and resignations will be given in "Society News." The current list follows:

Reinstatements

ANDERSON, MARSHALL PATTON, Assoc. M., Asst. Works Mgr., Brown Shipbuilding Co. (Res., 2010 Banks), Houston, Tex., reinstated Jan. 1, 1949.

BAROFSKY, MAX, M., Engr., Constr., Bureau of Highway & Street Cleaning, Dept. of Public Works, City Hall Annex (Res., 7016 Old York Rd.), Philadelphia, Pa., reinstated Jan. 1, 1949.

BARRUS, ARTHUR WILLIAM, Assoc. M., Contr. Engr., 509 Fifth Ave. (Res., Hudson Terrace, Box 265, Piermont), N.Y., reinstated Jan. 1, 1949.

FOWLER, WILLIAM BINGHAM, M., City Engr., 104 No. Bellevue, Memphis, Tenn., reinstated Nov. 10, 1948.

HEALY, JOHN EDWARD, Jun., Constr. Engr., 707 Tatnall St. Wilmington, Del., reinstated Jan. 1, 1949.

PETERSON, WILLIAM MORRISON, Jun., Asst. Prof., Dept. of Eng. & Trades, No. Tex. Agri. College, Arlington, Tex., reinstated Jan. 1, 1949.

MANASSEH, NICOLAS ELIA, Assoc. M., Civ. Engr., Iraq Petroleum Co., Ltd., Haifa, Palestine, reinstated Jan. 1, 1949.

MORRISON, CHARLES WALDO, Assoc. M., With Cross & Brown Co., 270 Madison Ave., New York, N. Y., reinstated Jan. 1, 1949.

QUIRK, LOUIS FRANCIS, Assoc. M., 48 Home Ave., Middletown, Conn., reinstated Nov. 12, 1948.

WALKER, JOHN FRAME, Assoc. M., 19336 Frazier Dr., Rocky River, Ohio, reinstated Nov. 26, 1948.

Resignations

BARTON, ROLAND NEAL, Jun., 4091 Eastway Rd., South Euclid, Ohio, resigned Nov. 19, 1948.

BISHOP, JOHN REID, Assoc. M., Leroy, Ill., resigned Dec. 31, 1948.

BROWNE, NOLAN, Assoc. M., Box 575, Dallas, Tex., resigned Dec. 31, 1948.

DERN, HERBERT, Jun., 29 West 25th St., Bayonne, N.J., resigned Dec. 31, 1948.

DILLON, ROBERT EMMET, M., Boston Edison Co., 182 Tremont St., Boston, Mass., resigned Dec. 31, 1948.

DOUGLAS, LAWRENCE M., Jun., 528 Market St., San Francisco, Calif., resigned Dec. 9, 1948.

FLETCHER, THOMAS, Assoc. M., 5309 Gwynn Oak Ave., Baltimore, Md., resigned Dec. 2, 1948.

GIBSON, ARTHUR CLARK, Jun., Asst. Civ. Engr., City Traffic Eng. Bureau, 112 East Jefferson, Detroit, Mich., resigned Jan. 22, 1948.

HALLDEN, OTTO SEBASTIAN, Jun., Dist. San Engr., State Dept. of Public Health, Carlinville National Bank Bldg., Carlinville (Res., 116 West South St., Mount Sterling), Ill., resigned Dec. 10, 1948.

HANSEN, MELVILLE BIRGER, Jun., Lt., R.C.E., 3125 West 10th Ave., Vancouver, B.C., resigned Dec. 31, 1948.

KUNZE, WALTER WILLIAM, M., Brooklyn Union Gas Co., 176 Remsen St., Brooklyn, N.Y., resigned Dec. 31, 1948.

LEVITAN, PHILIP WOLF, Jun., Designer, Edwards & Hjorth, Cons. Engr., 1276 Sixth Ave. (Res., 817 West End Ave.), New York, N.Y., resigned Dec. 8, 1948.

NEILL, WILLIAM DONALD, Assoc. M., Lt. Col., Corps of Engrs., U.S.A., Bico, Transport Group Rail Branch, A.P.O. 757, Care, Postmaster, New York, N.Y., resigned Nov. 17, 1948.

NOBLE, WILLIAM HENRY, Assoc. M., 118 West Lambert Rd., Whittier, Calif., resigned Dec. 10, 1948.

OSTHUES, HENRY EVERETT, Jun., Hq., 34th AAA Brigade, Fort Bliss, Tex., resigned Nov. 29, 1948.

SHERMAN, ROBERT, Jun., 238 Vernon Ave., Brooklyn, N.Y., resigned Dec. 2, 1948.

SIMPSON, WILLIAM MCCRAY, Jun., Univ. of Kans., Lawrence, Kans., resigned Dec. 31, 1948.

TURNER, ROGER PARKHURST, Jun., Junior Res. Engr., State Highway Dept. (Res., 2411 West Collin), Corsicana, Tex., resigned Dec. 10, 1948.

WILSON, MAYBIN HOMES, M., Col., Corps of Engrs., U.S.A., Mil. Dept., Univ. of Tex., Austin, Tex., resigned Dec. 31, 1948.

TOTAL MEMBERSHIP AS OF DECEMBER 9, 1948

Members	7,235
Associate Members	9,350
Corporate Members	16,585
Honorary Members	44
Juniors	8,045
Affiliates	73
Fellows	1
Total	24,748
(December 9, 1947	22,433)

Mining Engineer Wins 1948 Alfred Noble Prize

ROBERT L. HOSS, mining engineer and member of the staff of the Humble Oil and Refining Co., Houston, Tex., has been awarded the Alfred Noble Prize for 1948 for his paper, "Calculated Effect of Pressure Maintenance on Oil Recovery," published in the September 1947 issue of *Petroleum Technology* of the American Institute of Mining and Metallurgical Engineers. Presentation of the prize will be made at the annual banquet of the Institute, to be held at the Palace Hotel in San Francisco on February 16.

Robert L. Hoss

Born in Tulsa, Okla., Mr. Hoss graduated from the University of Tulsa in 1942, with a bachelor of science degree in petroleum engineering. He was employed by the Phillips Petroleum Co. during his undergraduate summers and full time, following his graduation, until 1943 when he left for military service, which included two years in North Africa and the Middle East as an engineering officer in the U.S. Army Air Corps. He was honorably discharged with the rank of captain in January 1946.

After obtaining a master's degree in petroleum engineering from the University of Texas in January 1947, he was employed by the Kewanee Oil Co. for six months prior to becoming connected with the Humble Oil and Refining Co. In addition to membership in the AIMME, he is also affiliated with the American Association of Petroleum Geologists and the American Petroleum Institute.

Established in 1929, the Alfred Noble Prize was made possible by a fund contributed by Mr. Noble, former President of the ASCE. The prize, consisting of a cash award of $350 and a certificate, is awarded annually to a young member of one of the four Founder Societies or the Western Society of Engineers for a published technical paper of unusual merit.

Engineering Societies Library Conducts Survey

WITH A GRANT from the Engineering Foundation, the Engineering Societies Library is starting a survey to determine how it can better serve the profession in general and the members of the four Founder Societies in particular. Members of the survey committee are: Ole

Singstad, M. ASCE, chairman, Frank T. Sisco, George Sutherland, James S. Thompson, Jerome K. Wilcox, Robert H. Barclay, and Ralph H. Phelps, director of the library. The survey will be made by Richardson K. Wood.

To expedite the functioning of the Library board, the United Engineering Trustees, Inc., recently reduced its size from 22 to 12 members. The 1948–1949 board consists of James S. Thompson, chairman, Frank T. Sisco, vice-chairman, Harold M. Lewis, M. ASCE, William N. Carey, Executive Secretary ASCE, James Douglas, James L. Head, Prof. Theodore Baumeister, Prof. H. M. Turner, George Sutherland, K. W. Jappe, E. C. Meagher, and Ralph H. Phelps, secretary.

NEWS OF LOCAL SECTIONS

Scheduled ASCE Meetings

ANNUAL MEETING

New York, N.Y., January 19–21
(Board of Direction meets January 17–18)

SPRING MEETING

Oklahoma City, Okla., April 20–23
(Board of Direction meets April 18–19)

ANNUAL CONVENTION

Mexico City, Mexico, July 12–14
(Board of Direction meets July 10–11)

Coming Events

Central Ohio—Meeting at the Chittenden Hotel, Columbus, January 20, at 6:15 p.m.

Connecticut—Annual meeting at the City Club of Hartford, January 26, at 6:30 p.m.

Florida—Meeting at the Seminole Hotel, Jacksonville, January 13, at 7 p.m.

Louisiana—Meetings at the St. Charles Hotel, New Orleans—business session on January 13 at 3:45 p.m., and technical session on January 15, beginning at 9 a.m. Meetings to be held in connection with annual meeting of the Louisiana Engineering Society. Annual meeting of the Section at New Orleans on January 27, at 7:30 p.m.

Maryland—Meeting at the Engineers Club, Baltimore, January 12, at 8 p.m. Preceded by cocktails at 6 p.m. and dinner at 7 p.m.

North Carolina—All-day annual meeting at the Selwyn Hotel, Charlotte, January 10, beginning at 10 a.m. A banquet will be sponsored by the Charlotte Engineers Club at the Hotel Charlotte, January 10, at 7 p.m.

Philadelphia—Meeting at the Philadelphia Engineers Club, January 11, at 7:30 p.m. Dinner at 6 p.m.

Sacramento—Regular meetings every Tuesday at the Elks Temple, Sacramento, at 12:30 p.m.

Syracuse—Luncheon meetings every Wednesday in the dining room at the Yates Hotel, Syracuse, between 12 and 1 p.m.

Wisconsin—Dinner meeting in the ESM Building, Milwaukee, January 27, at 6:30 p.m.

Recent Activities

ARIZONA

A RESOLUTION URGING that the salary scale for civil engineers at the University of Arizona be raised to meet the ASCE recommended salary schedule was unanimously adopted at the Section's recent two-day fall meeting. Another resolution commended the survey of water investigations in the state being conducted by the U. S. Geological Survey as "vital to engineering work and the economic development of Arizona." The work of the Army Corps of Engineers in the state was discussed by Col. Dwight F. Johns, division engineer for the South Pacific Division at Oakland, Calif., at the evening banquet that opened the meeting. Speakers on the technical program heard the next day included J. W. Stanley, of the Office of River Control, U. S. Bureau of Reclamation, at Boulder City, Nev., who described the sedimentation survey of Lake Mead being conducted under a cooperative agreement by the Geological Survey, the Navy, and the Bureau of Reclamation; John A. Rau, chief engineer of the Allison Steel Co., at Phoenix, who discussed his experiences in the welding of aluminum; and William N. Wallace and J. B. Holmquist, members of the University of Arizona Student Chapter, who read papers on prestressed concrete and city paving problems, respectively. The Section's annual student award was presented to Lars Helmquist, of the University of Arizona, and Section members Thomas Maddock and Ralph I. Meeker received certificates of life membership in the Society.

CENTRAL ILLINOIS

METHODS OF TREATING insect attacks on wooden structures were described at a recent meeting by William K. Delaplane, Jr., who operates the Illini Pest Control Service. David A. Day was in charge of the program, which was sponsored by the Juniors of the Section. The principal speaker at another recent meeting was Maj. Aleck F. MacDonald, of the Army Corps of Engineers, who outlined the planning and other problems involved in construction of the Farm Creek Flood Control Project.

CENTRAL OHIO

TECHNICAL ASPECTS OF the growth and development of metropolitan Columbus were detailed by a panel of engineers at a joint meeting with the Columbus Technical Council. Appearing in the symposium were Harry Turner, city traffic engineer; Philip Burgess, Columbus consultant; A. P. Harness, of the Jennings-Lawrence Co.; Grover Clements, Franklin County planning engineer; and Perry Shoemaker, Columbus planning engineer. The guest of honor and principal speaker for the occasion was Dr. E. U. Condon, director of the National Bureau of Standards, who outlined the many fields of research in which the Bureau is active. New officers for the Section, elected at the December meeting, are Clarence D. Bowser, president; Joseph F. Barbee, first vice-president; Howard E. Bonham, second vice-president; and Emmett H. Karrer, secretary-treasurer. A talk on the glacial history of southwestern Ohio—given by Richard P. Goldthwait, professor of geology at Ohio State University—comprised the technical program.

CINCINNATI

DESIGN AND CONSTRUCTION procedures employed in building Cincinnati's new Third and Walnut Parking Garage, a flat arch structure, were described at a recent Section meeting by J. R. Biedinger, consulting engineer on the project. An enthusiastic discussion from the floor concluded the program.

COLORADO

JOHN R. RITER, chief of the Hydrology Division of the Bureau of Reclamation, spoke on the Colorado River Compact for distribution of the water of the upper river basin at a recent meeting. Executed in October by commissioners from the states of Arizona, Colorado, New Mexico, Utah, and Wyoming, the compact pro-

vides for the allocation of water to each of the signatory states except for power purposes. The compact does not cover the engineering details of allocation, and ratification is necessary before the Bureau of Reclamation can proceed with major developments. It will be presented to the state legislatures for ratification in 1949 and, later, to Congress.

ILLINOIS

SECTION OFFICERS FOR 1949, elected at the annual meeting on December 6, are C. H. Mottier, president; W. S. Lacher, first vice-president; O. K. Jelinek, second vice-president; and E. M. Fucik, treasurer. Howard F. Peckworth continues as secretary. A talk on "Showmanship in Engineering," by Lenox R. Lohr, president of the Chicago Museum of Science and Industry, comprised the technical program.

IOWA

SOCIETY DIRECTOR DAVID L. Erickson attended a recent afternoon business meeting of the Section, held at Des Moines, and discussed current ASCE activities. Other speakers for the occasion were Joseph H. Byrd, president of the Student Chapter at Iowa State University, and Albert Sieck, president of the Iowa State College Chapter, who outlined the work of their Chapters. In the annual election of officers, Paul V. Roberts was elected president, and C. J. Posey, vice-president. Lowell O. Stewart will continue as secretary-treasurer. Later the group held a joint dinner meeting with the Des Moines Engineers Club. A discussion of the city manager plan—given by Roy Miller, of the Des Moines Taxpayers Association, and John Ames, city manager of Ames, Iowa—constituted the technical program. During the evening, Director Erickson presented a certificate of life membership to R. B. Kittredge, professor of transportation engineering at the University of Iowa.

FLORIDA

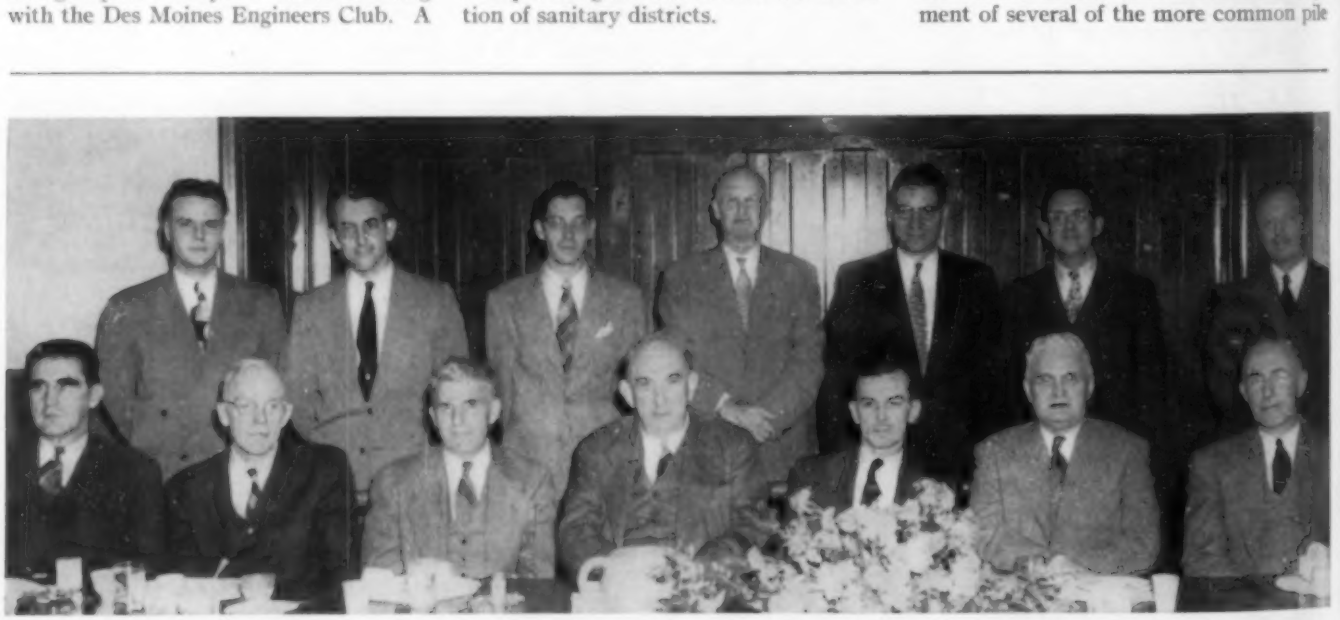
RECENT ACTIVITIES OF the ASCE Board of Direction were summarized by Executive Secretary William N. Carey at a regular dinner meeting of the Section. Colonel Carey discussed, particularly, the budgetary curtailments necessitated by failure of the amendments for increasing dues. In the featured address of the evening, Prof. John Kiker, of the department of sanitary engineering at the University of Florida, presented a paper on "Water Supply and Sewerage Facilities for Realty Subdivisions." Formerly with the New York State Board of Health and the City of Yonkers, Professor Kiker related experiences he had encountered as a result of improper consideration being given to water supply and sewage disposal in real estate subdivisions. In discussing his paper, David B. Lee, chief engineer of the Bureau of Sanitary Engineering of the Florida State Board of Health, stated that the Board is trying to obtain enactment of an enabling bill in the coming state legislature that would set up the legal mechanics for the formation of sanitary districts.

GEORGIA

SPECIFICATION AND CONSTRUCTION costs were discussed from both the engineering and contracting point of view at the December meeting. The engineer's viewpoint was presented by William H. Mills, Jr., chief of the Airport Engineering and Construction Division of the Civil Aeronautics Administration at Atlanta, and Searcy B. Slack, Decatur consultant, gave the contractor's position on the subject. Other technical speakers were John C. Sprague, engineer in charge of the Army Corps of Engineers Materials Testing Laboratory at Marietta, Ga., whose subject was "Materials Laboratory Function in Design," and R. D. Marbury, Jr., who discussed the topic, "Proposed Surveyor and Plat Law." Executive Secretary William N. Carey was the guest of the Section for the occasion and spoke on Society affairs. New officers, elected during the business session, are: T. H. Evans, president; James M. Roberts, resident vice-president; and Raymond J. Gauger, nonresident vice-president.

KANSAS CITY

SOIL MECHANICS ASPECTS of pile design and driving was the subject of discussion at a recent meeting, sponsored by the Junior Activities Committee. The principal speaker was Karl V. Taylor, head of the Embankment and Foundation Design Section of the Kansas City District of the Corps of Engineers, who described the various factors considered in development of several of the more common pile



HEAD TABLE AT RECENT JOINT MEETING of Indiana Section, with Student Chapters from Notre Dame, Purdue University, and Rose Polytechnic Institute, is pictured here. Left to right, seated, are B. B. Lewis, Faculty Adviser for Purdue Chapter; Carl Wischmeyer, acting president of Rose Polytechnic Institute; E. A. MacLean, professor of civil engineering at Rose; ASCE President R. E. Dougherty; C. E. Vogelgesang, president of Indiana Section; Ralph B. Wiley, ASCE Vice-President, Zone III; and E. H. McGovern, district engineer, Big Four Section, New York Central System. Standing, in same order, are presidents of Notre Dame, Purdue, and Rose Polytechnic Chapters; R. E. Hitchins, Faculty Adviser for Rose Chapter; K. B. Woods, secretary-treasurer, Indiana Section; W. L. Shilts, professor of civil engineering at Notre Dame; and Rev. Thomas Mabley. President Dougherty made special trip to Terre Haute to address group on career opportunities for young engineers in railroading.

formulas. In his opinion, load-bearing tests carried to failure are the best answer to the problem of pile-bearing power at present. Following Mr. Taylor's talk, members of a permanent Section panel of discussers—Richard R. Tipton, Josef Sorkin, and Leo Boswell—commented on various aspects of the problem. Remarks were also contributed by Professors G. W. Bradshaw, D. D. Haines, and T. F. McMahon, of the University of Kansas. At another recent Section meeting, the proposed Jackson County Charter was discussed by Delos C. Johns, Kansas City banker and chairman of the Jackson County Charter Committee.

KENTUCKY

THE WARTIME CONSTRUCTION of three airfields on the rugged terrain of New Guinea, using only native labor and without modern equipment, was described at the Section's annual meeting by Maj. Gen. L. J. Sverdrup, St. Louis consultant. A motion picture supplementing his talk showed thousands of natives tramping back and forth to pack the runways (a human sheepsfoot roller), transportation and dumping of earth fill by basket; and other primitive labor conditions. During the war, General Sverdrup was engineering assistant to General MacArthur in the Southwest Pacific Theater. The following officers for 1949 were elected at the meeting: Floyd F. Schrader, president; J. Frank Grimes, vice-president; Cedric L. Cowan, secretary-treasurer; and John Clark, corresponding secretary.

LOS ANGELES

TECHNICAL SPEAKERS AT the December meeting were Frank L. Flood, consultant to the City of Los Angeles on the design of the Hyperion Sewage Plant, whose subject was "Development Through Sewage Treatment"; and John M. Server, Jr., editor of *Western Construction News*, who described the Reber Plan for the development of San Francisco Bay. During the evening certificates of life membership were presented to Frederic A. Batty, John W. B. Blackman, Orrin F. Cooley, Fred O. Dolson, Chester G. Gillespie, Frank B. Kendall, Clarence B. Osborne, Charles W. Petit, William Reinhardt, Ralph E. Spaulding, Ralph W. Stewart, H. A. Van Norman, and Paul R. Watson. New Section officers, elected at the recent Ladies' Night, are: D. Lee Narver, president; R. R. Shoemaker and Sterling Green, vice-presidents; and Homer W. Jorgenson, secretary. Robert J. Kadow will continue as treasurer. On the same occasion, Section awards of Junior membership were presented to Tom Waters, of the California Institute of Technology, and Walter N. Clark, of the University of Southern California.

New Junior Forum officers are Stanley Butler, president; Joseph Hyde, vice-president; and Warren Curtis, secretary-treasurer.

LOUISIANA

FUNCTIONS AND OPERATION of the New Orleans City Engineer's office were detailed at a recent meeting in a paper, prepared by City Engineer Albert Wyler and read by Louis M. Buja in Mr. Wyler's absence. Mr. Buja, who is on the City Engineer's staff, used a chart to give a graphic picture of the organizational set-up of the office and its many functions.

MARYLAND

DESIGN AND CONSTRUCTION features of the proposed Chesapeake Bay Bridge, now in the design stage, were reviewed at a recent dinner meeting by Raymond Archibald, associate engineer for the J. E. Greiner Co., of Baltimore. Mr. Archibald, who is in charge of the design and construction of the bridge, stated that the bay crossing will total about 23,000 ft in length. The main bay channel will be traversed by a three-span suspension unit, providing a clear 1,500-ft horizontal opening for navigation and vertical clearance of 186.5 ft. A through cantilever unit will span the secondary channel adjacent to the Eastern Shore. Special precautions, such as bleeding strips in the bridge deck and use of a double lateral system, are being used to prevent torsional oscillation of the suspension span. It is expected that about two years and eight months will be required for completing the structure, and construction costs are estimated at $32,500,000.

METROPOLITAN

CURRENT ACTIVITIES OF the Junior Branch include biweekly technical programs covering a wide range of subjects. Recent speakers include Harry Jordan, secretary of the American Water Works Association, who explained vocational possibilities for the young engineer in water works, and Edward J. Cleary, executive editor of *Engineering News-Record*, whose subject was "Building Bridges with Words."

MID-MISSOURI

THE ENGINEER'S PLACE in the current economy was analyzed by Curtis L. Wilson, dean of the Missouri School of Mines and Metallurgy, at a joint meeting of the Section and the Student Chapter at the Missouri School of Mines. A motion to allot $25 each to the Student Chapter and to the University of Missouri Chapter for welfare and expansion was made.

MONTANA

VARIOUS ASPECTS OF the Montana Registration Law were discussed at a recent meeting by a panel from the State Engineer Registration Board, headed by John H. Morrison, of Helena, chairman of the board. Appearing on the program were E. R. Dodge, head of the Montana State College civil engineering department and secretary of the board; Dean A. E. Adami, of the Montana School of Mines; R. J. Hale, county engineer from Missoula; and S. D. Waldorf, county engineer from Bozeman.

MIAMI

IN A TALK on Miami's improvement program, given at the December meeting, O. P. Hart, city manager, emphazied the expansion of city facilities required by the rapid growth of the city, and praised the Florida Power and Light Co. and the telephone company for their vast improvement programs. Projected city improvements include a sewer and disposal-plant project, a new library, and a $4,500,000 water works program. Miami's Recreation and Convention Bureau has made it one of the few cities in the country that can handle conventions as large as the American Legion, Mr. Hart pointed out.

NORTHEASTERN

ALMOST 200 STUDENT CHAPTER members from the 14 engineering colleges in the New England area attended a joint meeting of the Northeastern Section and the Boston Society of Civil Engineers, held at Northeastern University. The technical program for the occasion consisted of an illustrated talk on vehicular tunnels by Ole Singstad, former ASCE Director and authority on tunnel construction.

PHILADELPHIA

REVIEWING THE SCHUYLKILL River restoration project, which the state of Pennsylvania is currently undertaking, at a joint meeting with the local branch of the ASME, Comdr. E. S. McCawley stated that for over a century the river has been subjected to serious pollution from the culm and mine wastes of the anthracite region. Alarmed by the situation, the state finally commissioned a council of engineering firms to design and supervise letting of contracts for the restoration of the river. State legislation now prevents further pollution. It is expected that restoration will be completed by the end of 1951, most of the contracts being under construction and several completed. Commander McCawley has been serving as deputy in charge of the project.

OREGON

ASCE PAST-PRESIDENT J. C. Stevens was principal speaker at a recent dinner meeting. Developing the topic, "Keys to Prosperity," Mr. Stevens explained

the correlation among various economic factors and how they can be used to foretell future trends. The remainder of the program consisted of a talk by Lewis Stanley, of the Army Engineer Office at Portland, who described his experiences while on duty in Afghanistan.

PITTSBURGH

PROBLEMS INVOLVED IN the construction of rigid pavements that will withstand the impact of modern heavy aircraft were discussed by R. R. Philippe, director of the Ohio River Division Laboratories of the Corps of Engineers, at a joint meeting with the Pittsburgh post of the Society of American Military Engineers and reserve units of the Engineers Corps in Allegheny County. On December 6, the Section participated in a meeting sponsored by the Pittsburgh branch of the ASME. The program, which emphasized the professional aspects of engineering, consisted of talks by T. F. Hatch, research director for the Industrial Hygiene Foundation, and John Rice, Pittsburgh consultant and member of the State Registration Board.

PROVIDENCE

A SYMPOSIUM ON the state of Rhode Island's pollution abatement program featured a recent meeting. The speakers were Charles G. Hammann, chief engineer of the Blackstone Valley Sewer Commission, who summarized the events leading to the formation of the commission, and E. Sherman Chase, of the Boston firm of Metcalf & Eddy, who detailed his firm's investigations in the field. At another recent meeting, Henry L. Kennedy, manager of the cement division of the Dewey & Almy Chemical Co., spoke on the topic, "Increased Durability of Concrete Through Air Entrainment," and predicted a wide increase in the use of the process.

ROCHESTER

ASCE DIRECTOR Harland C. Woods attended a meeting of the Section and spoke on recent Society activities, commenting particularly on the need for curtailment of the budget. The technical program consisted of a talk by Allen C. Bailey, water development engineer for the Eastman Kodak Co. Mr. Bailey discussed the problem of water supply for large industrial organizations and gave an illustrated description of the new intake installation for Kodak Park. Following a custom of many years, the Section sponsored the Rochester Engineering Society's weekly luncheon program for the first month of the new season. As chairman of the ASCE month, Harry W. Eustance presented talks by Edward F. Nier, commissioner of public works; J. Burch McMorran, district engineer for the New York State Department of Public Works; and Joseph Bevacqua, director of the Monroe County Planning Commission.

TENNESSEE VALLEY

THE KNOXVILLE SUB-SECTION was host to engineers throughout the area at the annual two-day fall meeting of the Tennessee Valley Section, held recently at the Andrew Johnson Hotel in Knoxville. The program committee, headed by James F. Goddard, had arranged a Friday afternoon technical program featuring "Conservation of Natural Resources." Joseph L. Fisher, member of President Truman's Council of Economic Advisers, gave the principal address on the subject, and discussions were contributed by Harcourt Morgan, former member of the Board of Directors of the Tennessee Valley Authority, and Howard Menhinick, director of the TVA Division of Regional Studies. During the business meeting following the technical session, E. M. Titus was elected president for 1949, and Raymond Forshay vice-president. E. L. Chandler, ASCE Assistant Secretary, then headed an enthusiastic discussion of Society affairs. Exhibits of regional activities were displayed at the dinner dance Friday evening by the TVA, the Knoxville City Planning Commission, the Robertshaw Fulton Controls Co., the Volunteer Portland Cement Co., and the University of Tennessee. The meeting was concluded Saturday morning with a visit to the American Enka Corp., near Morristown, Tenn., and a luncheon at the plant.

GROUP OF SPEAKERS AND SECTION OFFICERS poses for photograph at fall meeting of Tennessee Valley Section. Reading, left to right, are E. Lawrence Chandler, ASCE Assistant Secretary; Joseph L. Fisher, member of President Truman's Council of Economic Advisers; and W. N. Calvert, Jr., and Ernest M. Titus, president and president-elect of Tennessee Valley Section.

SACRAMENTO

RECENT SPEAKERS AT the traditional Sacramento Section luncheon meetings include Bert Smith, director of education for the Irrigation District of California, who discussed legislative aspects of the development of water supply in the West; Norman Sturm, economist with the State Division of Water Resources, whose subject was "The Field of Economics in Engineering"; and Fred Sprague, who presented a Standard Oil film, "The Amazon Awakens."

WEST VIRGINIA

INSPECTION BY BOAT of Marmet Dam and the adjacent hydroelectric plant preceded a recent dinner meeting of the Section. The structures were veiwed under the supervision of Robert Steele, of the U.S. Engineer Office at Huntington, and Paul Johnson, of the Kanawha Valley Power Co. Operation of the locks in the river was explained by the lockmaster, and technical questions were cleared by J. M. Cooke, of the U.S. Engineer Office. The principal speaker at the evening meeting that followed the trip was Gail A. Hathaway, ASCE Vice-President and Special Assistant to the Chief of Engineers, Department of the Army. Mr. Hathaway discussed the construction and rehabilitation of dams and hydroelectric plants in Europe, which he visited during the past summer. He stated that European nations are proceeding with an ambitious program of hydroelectric projects, and are constructing them in such a way as to give maximum protection in case of war. Section officers for 1949 are J. N. Wallace, president; R. V. Engstrom, vice-president; and Kenath A. Kettle, secretary-treasurer.

NEWS BRIEFS

Construction Volume for 1949 Is Expected to Top 1948 Figure

TOTAL NEW CONSTRUCTION in 1949 is expected to reach $18.75 billion, setting a new dollar-value record for construction work. The expected total—a joint estimate of the Departments of Commerce and Labor, given in a recent Department of Commerce Industry Report—represents an increase of more than 5 percent over the $17.8 billion figure now in prospect for 1948. The physical volume of construction in 1949, however, will apparently be about the same as in 1948, remaining appreciably below previous records for physical volume set in the nineteen twenties and 1942.

In the field of new private construction, the 1949 outlook is for a dollar-value total of $13.75 billion, substantially the same as the apparent total for 1948. New public construction for the coming year is estimated at $5 billion—an increase of almost $1 billion, or 24 percent, above the total for 1948.

Private residential construction, exclusive of farms, will continue to be the largest single component of new construction and, at $6.5 billion, is expected to constitute about 35 percent of the total. However, this estimate represents a drop of more than 8 percent from the 1948 figure of $7.1 billion.

Aside from residential building, increases are expected in most fields of private construction, with private nonresidential building as a whole estimated at just above $4 billion in 1949, an increase of 12 percent over the probable 1948 total. This increase results from an estimated 15 percent rise in commercial construction (warehouses, office and loft buildings, and stores, restaurants, and garages), and a 35 percent increase in all other types of private nonresidential building, including private educational buildings, churches, and hospitals. These expected gains are only partly offset by an expected 6 percent decrease in industrial construction. Privately owned public utility construction will probably reach $2.75 billion, a rise of 8 percent over the total for 1948.

Almost half of the increase in public construction is due to an anticipated 42 percent advance in public nonresidential building, to a total of $1,375 million—an increase resulting chiefly from substantial advances in construction of hospital, institutional, and educational buildings. Other important increases in public construction in 1949 are expected to appear in conservation and development, up 25 percent to $750 million; highway construction, up 10 percent to $1,700 million; and sewer and water construction, up 22 percent to a total of $550 million.

The foregoing estimate is derived from consideration of the present level of the various types of construction, recent construction trends, and known forces currently operating to affect the future. In the case of residential construction, the figures for value of work to be put in place during the coming year are based on an estimate that construction will be started on about 875,000 new permanent dwelling units, private and public. Practically all this residential construction will be privately owned, with the number of publicly owned units to be started estimated at only about 30,000.

In addition, certain specific assumptions have necessarily been made. The more important of these are: (1) That no general business recession will occur in 1949; (2) that expenditures for national defense and foreign aid will not expand substantially above present levels and that demands from these sources will not seriously affect the volume of materials available for domestic construction; and (3) that construction costs for the year will average about 5 percent above the average for the entire year 1948.

ASCE Members Participate in Florida Health Conference

CONSIDERATION OF THE economic factors involved in the stream pollution problem was urged by ASCE Executive Secretary W. N. Carey in a talk given at the recent first Annual Public Health Engineering Conference, sponsored by the civil engineering department at the University of Florida and numerous other interested organizations. Speaking at a banquet on the first evening of the conference, Colonel Carey described the menace of stream pollution from a public health standpoint. However, he stated that a sound solution of the problem cannot be achieved by the wholesale construction of sewers and treatment works. Advocating increased attention to economic considerations, he said that a proper economic balance will be reached "when treatment is just adequate to produce consistently in the receiving water a condition commensurate with the uses of the water."

The two-day session was opened by C. D. Williams, M. ASCE, head of the civil engineering department at the University of Florida, who outlined the aims of the conference. Professor Williams stated that a survey of local conditions indicates the state's greatest public health engineering need is for information on economically adequate sewage treatment processes.

Other ASCE members represented on the technical program include David B. Lee, chief sanitary engineer for the Florida State Board of Health, who described the state's stream pollution problems; Wylie W. Gillespie, Jacksonville consultant, who analyzed present-day costs of sewerage and sewage treatment; Joe Williamson, Jr., consulting engineer of Daytona Beach, who discussed other economic aspects of stream sanitation; and Carl E. Schwob, sanitary engineer for the U.S. Public Health Service, Washington, D.C., who spoke on national legislation relating to stream pollution and the possible influence of this legislation on the state's stream sanitation program.

The closing speaker was J. E. Kiker, associate professor of public health engineering, University of Florida. Professor Kiker summarized "Advantages of Stream Sanitation as Related to the Long-Range Economy of Florida," the conference theme.

Third in a series of annual congresses on widely divergent subjects planned and sponsored by the civil engineering department at the University of Florida, the conference was attended by 181 persons representing more than 50 health, administrative, planning, civic, and recreational organizations. The Florida Section of the Society was one of the sponsoring groups.

Steel Production Sets Peacetime Record in 1948

MORE THAN 88,000,000 tons of raw steel, the equivalent of over half of the world's output, was produced during 1948, according to a recent release of the American Iron and Steel Institute. Representing about 94 percent of all the metals produced in the United States, this steel tonnage is the largest peacetime output on record and lacks only a few days' production of reaching the top wartime output of steel achieved in 1944.

Even more impressive than the total output for the year was the unprecedentedly high production reached in the autumn of 1948. An all-time monthly tonnage output was established in October, and a new weekly production record set in November—at the rate of 94,000,000 tons per year. According to the Institute, these feats reflect the results of the large-scale postwar programs of expansion and improvement undertaken by the steel companies.

Predicting that the output for the coming year will be even higher than the 1948 total, the Institute places it at above 90,000,000 tons, "if the necessary raw materials such as scrap and coal are available and no interruptions of production occur."

Screw-Thread Standards Unified by Recent Pact

WITH THE SIGNING of a recent agreement unifying standards for screw threads and other threaded components used in industry—by representatives of the United States, Great Britain, and Canada—an 80-year barrier to industrial and military cooperation between these countries was removed.

Meeting with representatives of the three nations at the National Bureau of Standards in Washington for the ceremony of signing the pact, William L. Batt, former vice-chairman of the War Production Board and chairman of the Sponsors Council of the U.S.-U.K. on Unification of Screw Threads, stated that "the agreement will enable democratic military forces to work together most effectively and will help industry give the best satisfaction to its foreign customers."

Early in the war, all lend-lease equipment shipped abroad had to be accompanied by spare parts because of a 5-deg angle difference in the screw threads of British, Canadian, and American gun parts of identical design. A temporary standard, adopted to eliminate this problem, expired at the close of the war. Since then the situation has been under study by representatives of the American Standards Association and American, British, and Canadian engineering societies, under the auspices of the Sponsors Council.

Silt Survey of Lake Mead Shows Need for New Dams

RESULTS ALREADY OBTAINED in a silt survey of Lake Mead—being conducted under a cooperative agreement by the Navy, the U.S. Bureau of Reclamation, and the U.S. Geological Survey—indicate that the useful life of the lake can be preserved for many years if certain precautions are taken. These precautions include building new dams on the Colorado River above Hoover Dam to check river deposit and proper regulation of river flow, according to C. P. Vetter, M. ASCE, head of the Office of Colorado River Control.

Core samplings taken in the present survey indicate that, in the 13 years since completion of Hoover Dam, sedimentation deposits ranging in depth from as little as 4 ft in the Virgin River arm of the lake to as much as 260 ft from the Colorado River have been poured into the lake. With the rate of Colorado River deposit averaging 400,000 tons per day, a total of about 2 billion tons of muck has been deposited in the lake to date.

Proposed remedies include building the projected Bridge Canyon Dam about 125 miles above Hoover Dam, and Glen Canyon Dam, a few miles above Lee Ferry. With a height equal to Hoover Dam, although impounding only one-tenth as much water, the Bridge Canyon Dam would arrest enormous quantities of silt now entering Lake Mead. Similarly, the Glen Canyon Dam would stop vast amounts of sedimentation reaching the Hoover Dam area. Although the Bureau of Reclamation has prepared detailed surveys for the Bridge Canyon Dam, construction of the project is involved in the California-Arizona controversy over Colorado River water. However, it is hoped that work on the dam will be authorized by Congress and construction started, while the California-Arizona settlement is worked out.

National Research Council to Correlate Research in Building Construction

A BUILDING RESEARCH Advisory Board has been designated by the National Research Council to coordinate private and public research in building construction. The new board is sponsored by the Council and the National Academy of Sciences.

According to recent estimate, $25,000,000 per year is being spent in research on building construction. Contributing to this sum are producers and manufacturers of building materials and equipment, who wish to improve their products; builders, contractors, and organizations of engineers and architects, who are conducting their own researches for ways of saving materials and man-hours of labor on their specific projects; and several universities and foundations, which have established building construction courses and research projects.

In the latter category, the University of Illinois Small Homes Council has made a practical contribution, in its Bulletin E 2.1, toward saving up to 20 percent in man-hours of labor over conventional methods. The bulletin describes the construction of the rather simple "industry engineered" house developed by the Producers Council and the National Retail Lumber Dealers Association—a five room, 800-sq ft, bungalow-type residence. Government agencies, such as the Forest Products Laboratory, the Bureau of Standards, and the Housing and Home Finance Agency, also are studying the many phases of building operations.

To fill the need for an agency to correlate the results of such research for the benefit of the whole building construction industry, the Construction Industry Advisory Council, with ASCE Past-President John C. Stevens acting as chairman, proposed to the National Academy of Science, through the National Research Council, that it set up a Building Construction Advisory Board, patterned in its organization and operation after the Highway Research Board.

The challenge to thus reduce the economic waste of duplicate researches was accepted by the National Research Council, and its Building Research Advisory Board has been designated as a clearing house for all scientific and technological research in the design, construction, maintenance, and better adaptation for use of homes, factories, hospitals, hotels, and office buildings. Studies will extend to materials and to both factory and site methods. An initial five-year program of coordination and reporting will be undertaken by the Board at an approximate cost of $100,000 a year.

Frank B. Jewett is chairman of the Board, which consists of 22 eminent scientists, engineers, contractors and architects. ASCE members include W. E. Reynolds, Commissioner of Public Works; Harold A. Vagtborg, president of the Midwest Research Foundation; Charles R. Tompkins, contractor; Elmer K. Timby, chairman of the Department of Civil Engineering at Princeton University; Harry C. Plummer, research engineer, Structural Clay Products Institute; and Richard G. Kimbell, director of technical services for the National Lumber Manufacturers Association. Offices of the organization are at 2101 Constitution Avenue, Washington 25, D.C.

Oregon to Have First Snow-Melting Highway

IN FIRST APPLICATION of radiant heating principles to road construction, stretch of Dalles-California Highway leading into Klamath Falls, Ore., will be heated by hot water from underground spring circulated through 15,000-ft network of welded wrought-iron pipe laid in concrete. Road will remain skid-free in all weather by automatically melting snow and ice. Idea developed by G. S. Paxson, M. ASCE, bridge engineer, Oregon Highway Commission.

Basic Building Codes Now Near Completion

WIDESPREAD ACTION IS being taken to revise building codes to meet the development of new and improved materials of construction and improved knowledge of their properties. Modern codes are based on functional standards of performance rather than detailed requirements for specific materials and methods of using them.

Considerable progress has been made by the Building Officials Conference of America, Inc., on its basic Building Code designed for use in the 1,200 large cities of the country, and on its Abridged Building Code for the smaller community which is inadequately staffed to administer the more comprehensive basic code.

The A.B.C. (Abridged Building Code) document is written in simpler terms, with tables and design data covering details of acceptable traditional forms of construction. Covering buildings of all-use groups, which are not more than three stories or 40 ft in height, this code is intended for communities in which the general range of building operations falls within that scope. Projects of greater magnitude or unusual technical design are referred to the Basic Building Code, which is made complementary to the abridged document.

According to present plans, a revised edition of the Basic Building Code will be available early in 1949. A mimeographed issue of the approved 139-page Abridged Building Code can be obtained now from the Building Officials Foundation at 51 East 42d Street, New York 17, N.Y., for $5 per copy.

The Federal Housing and Home Finance Agency, through its Division of Standardized Building Codes and Materials, expects to undertake technical research and study to promote acceptance of standard building codes, but does not contemplate the drafting of a building code. The Agency is issuing a series of technical bulletins for the solution of specific problems in building construction, of which the sixth is now available.

Highway Research Board Holds Annual Meeting

NOTABLE ADVANCES IN the science of soil mechanics were reported in 17 papers presented at the 28th Annual Meeting of the Highway Research Board held in Washington, D.C., December 7 to 10. Among these were "Thermal Conductivity of Soils" by Miles Kersten, Assoc. M. ASCE, of the University of Minnesota; "Separation, Fractionation, and Mineralogy of Clays in Soil" by J. H. Havens, J. L. Young, Jr., and R. F. Baker, Assoc. M. ASCE, of the Kentucky Department of Highways; and "Some Numerical Solutions of Stresses in a Two-Layered System" by R. J. Hank and F. H. Scrivner, of the Texas Highway Department.

Another technical session attracting considerable attention was the symposium on asphalt-mix design, presided over by Gen. J. S. Bragdon, of the Corps of Engineers. This session highlighted the work of the Waterways Experiment Station at Vicksburg, Miss., in design and control of asphalt mixtures and the correlation between laboratory data and field performance of various mixtures. ASCE members participating included Prof. Lloyd F. Rader, of the University of Wisconsin; Gayle McFadden, of the Office of the Chief of Engineers; and J. M. Griffith, W. K. Boyd, C. R. Foster, W. G. Shockley, and W. J. Turnbull, of the Waterways Experiment Station.

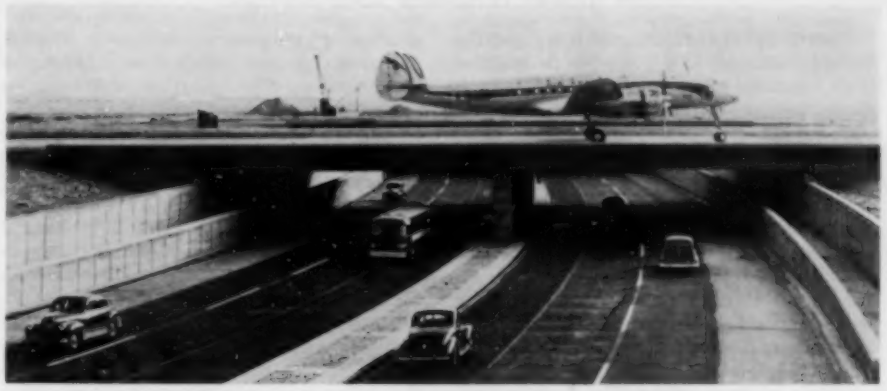
In all 104 papers and reports, covering all phases of highway administration and technology, were presented at the 18 technical sessions. Synopses of these are being published in the December issue of *Highway Research Abstracts*, single copies of which are available from the Highway Research Board, 2101 Constitution Avenue, Washington, D.C., at 50 cents.

F. V. Reagel, engineer of materials for the Missouri State Highway Department, was reelected chairman of the Executive Committee, and Prof. R. A. Moyer, Assoc. M. ASCE, of Iowa State College, vice-chairman. Reelected to the executive committee for three-year terms were Burton W. Marsh, M. ASCE, director of the safety and traffic engineering department of the American Automobile Association, and Charles M. Upham, engineer-director of the ARBA.

Featured at the general session on December 8 was the presentation of the Bartlett Award to G. Donald Kennedy, M. ASCE, vice-president of the Automotive Safety Foundation. The Highway Research Board Award for the outstanding paper presented at the 27th Annual Meeting went to C. R. Hanes, field engineer for the Ohio Department of Highways, and the Distinguished Service Award for achievement in highway research to Frank H. Jackson and Prof. Charles H. Scholer, M. ASCE.

The registered attendance of 904, largest in the history of the Board, represented nearly all states and nine foreign countries.

Air and Surface Traffic Coordinated at Idlewild Airport



HUGE AIRLINER TAXIS OVER NEW CONCRETE UNDERPASS at New York International Airport. Recently completed at cost of $4,250,000, parkway and underpass permit simultaneous movement of aircraft and surface vehicles. Underpass is "concrete boat" built to withstand pressure below sea level and sustain two taxiway bridges, each capable of supporting 300,000-lb planes. New York firm of Carillo & Green Associates were engineers for Port of New York Authority on construction of road and underpass.

Report of Governor of Panama Canal Available

INVESTIGATIONS AND STUDIES made by the Governor of the Panama Canal as a means of increasing the capacity and security of the Canal to meet future commercial and defense needs have been made available in nine volumes, entitled *Report of the Governor of the Panama Canal*. Authorized by the 79th Congress, under the provisions of Public Law 280, the investigations were initiated by assembling all available information on 30 possible canal routes across the Isthmus. Concurrently, methods were analyzed for increasing the capacity and security of the existing Panama Canal. The Governor's Report may be studied in the Engineering Societies Library and other leading technical libraries.

Several of the Panama Canal studies were published in the February 1947 issue of PROCEEDINGS, and the April 1948 number was devoted to a special Panama Canal symposium.

Essay Contest Open to Young Members of ESNE

TO STIMULATE THINKING along professional lines among the younger members of the Engineering Societies of New England, the organization is offering three cash prizes totaling $100 for the best essays of 2,500 words or less on the subject, "The Obligations of the Engineer to a Free Society." Eligible for competition are all members of the constituent societies of ESNE who will not have reached their 30th birthday by March 1, 1949, deadline for the submission of entries. The essay winning first prize may be presented at the annual meeting of the ESNE in April 1949.

Details of the contest may be obtained from the president of ESNE, Dean William C. White, of Northeastern University, Boston, Mass., or from the November 1st issue of the ESNE Journal.

Army Reserve Commissions Available for Civil Engineers Without Military Experience

RESERVE COMMISSIONS IN the Army of the United States are now available to qualified civil engineers able to meet the requirements of age, education, experience, and physical condition. These commissions range from second lieutenant through colonel, depending upon the applicant's qualifications and experience in his specified field. Applicants must be United States citizens, between 21 and 55. No previous military experience is required.

A bachelor's degree in civil engineering or in a related field of engineering, such as architecture, landscape architecture, architectural engineering, construction engineering, sanitary or public health engineering, railway engineering, agricultural engineering, highway engineering, petroleum engineering, and mining engineering, qualifies for appointment into the Officers' Reserve Corps.

For appointment in grades of first lieutenant through colonel, with certain exceptions, applicants must meet the minimum requirements of a bachelor's degree as stated. In addition, applicants must have had further qualifying education or progressive professional engineering experience on any one or any combination of the following types of structures or projects: (1) Buildings and similar structures; (2) structures or systems involving right of way; (3) public health projects; (4) hydraulics engineering projects; (5) agricultural engineering projects and structures; (6) petroleum and natural-gas engineering projects; (7) mining engineering projects; or (8) other civil engineering work.

The foregoing experience may be in any one or any combination of the following activities: (1) Research; (2) planning, designing, layout, and location; (3) specification, regulation, or ordinance writing; (4) supervision of construction; (5) materials testing; (6) estimating, valuating, or appraising; (7) inspecting; (8) supervision of operation or maintenance; (9) management or administration; (10) technical writing or editing; (11) consulting; or (12) teaching at college level.

Determination of the grade in which the applicant will be commissioned is the function of the examining board which interviews the applicant, subject to final approval of the Adjutant General. Grades will be based on the total number of years of qualifying college education and/or experience, with the following scale of minimum requirements: Second lieutenant, 4 years; first lieutenant, 7 years; captain, 11 years; major, 16 years; lieutenant colonel, 21 years; and colonel, 26 years.

In addition, appointments will be made in surveying and mapping instruction specialties for service in the Corps of Engineers Reserve. The Reserve sections for which these appointments will be made are the Army Security Reserve, Chemical Corps Reserve, Corps of Engineers Reserve, Corps of Military Police Reserve, Medical Service Corps Reserve, Military Intelligence Reserve, Ordnance Department Reserve, Quartermaster Corps Reserve, Signal Corps Reserve, and Transportation Corps Reserve.

For service in the Corps of Engineers Reserve, professional experience with any of the types of civil engineering projects previously listed may be substituted for the educational requirements on a year-for-year basis.

Full details of the program for commissioning civilian civil engineers are provided in Department of the Army Circular No. 210, dated July 14, 1948. Application forms and Circular No. 210 may be obtained from local Reserve Unit Headquarters or from Organized Reserve Unit Instructors, or by writing to Army Headquarters in New York City, Baltimore, Atlanta, Chicago, Houston, San Francisco, or to the Adjutant General, Department of the Army, Washington 25, D.C.

ROUTE OF COLORADO RIVER AQUEDUCT on scale model display map is studied by, left to right, ASCE President-elect Franklin Thomas, Metropolitan Water District Board member from Pasadena and chairman of Colorado River Board of California; Raymond Matthew, M. ASCE, chief engineer of Colorado River Board; Preston Hotchkis, president of Colorado River Association; and ASCE Director Julian Hinds, general manager and chief engineer of Metropolitan Water District.

Modern Plant Built for Electronics Manufacture

ESPECIALLY DESIGNED TO meet the exacting requirements of precision electronic manufacture, the recently completed Allentown, Pa., plant of the Western Electric Co. represents the last word in "controlled conditions" structures. The new plant, which will employ 2,500 persons, is set in a landscaped tract of 50 acres, including recreation areas, parking lots, roads and sidewalks, and a railroad siding. It includes administration and manufacturing buildings, a powerhouse, and gas generation building.

Unusual flexibility of manufacturing layout is permitted on the main floor of the two-story manufacturing building by means of welded trusses of 100-ft span on 25-ft centers. Other notable structures include a reinforced concrete fire-protection reservoir supporting induced draft cooling towers, a well pump house, and an acid-neutralizing basin with associated pump house.

Throughout the units, complete control of temperature, humidity, air pressure, sound, and light has been provided. To achieve a controlled atmosphere, roofs and ceilings have been especially designed to seal off the interior from dust-laden outside air and to provide a time lag in transmission of solar heat. In summer the lag of heat transmission through the $13\frac{1}{2}$-in. walls is 12 hours, and employees will work in year-around temperatures ranging from 70 to 80 deg, with 40 to 55 percent relative humidity. Safety devices include electric eyes to act as smoke detectors in case of fire and ventilators that operate automatically in the event of the escape of hydrogen gas.

The new Allentown plant was designed and built by the Austin Co., under the supervision of the Western Electric Company's engineer of plants, at a cost of more than $10,000,000.

Competition in Welded Bridge Design Announced

TO ADVANCE THE progress of welded bridge design, the James F. Lincoln Arc Welding Foundation is sponsoring an award program, open to bridge and structural engineers, for the best designs for welded highway bridges. The first prize is $3,000; second prize, $1,500; and third prize, $750. In addition, there will also be ten honorable mention awards of $100 each for the next best designs.

Complete details of the contest may be obtained from the James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio. Entries close June 30, 1949.

Belt Transports Aggregate for Dam Construction

CONSTRUCTION ENGINEERS ADOPT mass production principle of conveyor system in moving 4,000,000 tons of aggregate from quarry to stockpile for use in construction of Bull Shoals Dam in northern Arkansas. Aggregate travels 7 miles over rugged terrain by means of 30-in. compounded rubber and cotton fabric conveyor belt, designed and built by Goodyear Tire and Rubber Co. Last phase of haul, which delivers 650 tons of crushed rock per hour at dam site, is shown here, with drive-house at top of tower above stockpile.

Films on Construction of Gas Pipeline Available

CONSTRUCTION OF "The Biggest Inch," a 1,200-mile natural gas pipeline extending from the Texas Panhandle to Sante Fe Springs, Calif., is featured in a one-reel, 35-mm cinecolor motion picture, recently released by Polaris Pictures, Los Angeles. At the request of gas company officials, the organization has also made a 16-mm, 30-minute technicolor sound film on the same subject, which is suitable for amateur presentation.

Prints of the 16-mm film, which is entitled "Westward Flow," are available for showing to schools, engineering societies, and other interested organizations. Requests may be made through gas company offices.

Army Engineers to Build Garza-Little Elm Project

GROUND-BREAKING CEREMONIES, held recently near Dallas, Tex., initiated construction of the Garza-Little Elm Dam and Reservoir Project, fourth in the series of projects being built by the Galveston District of the Army Corps of Engineers in the Upper Trinity River Basin. The others are the Benbrook, Lavon, and Grapevine projects. Incorporating the present Lake Dallas, the Garza-Little Elm Dam and Reservoir will consist of an earth dam about six miles long and approximately 125 ft high.

When completed the reservoir will provide 526,700 acre-ft of storage capacity and, in conjunction with the Grapevine Reservoir on the Denton Creek, will control floods originating in the Elm Fork Basin. The greater part of the reservoir capacity will be used for municipal and industrial storage, with the City of Dallas given storage capacity to replace its present storage in Lake Dallas.

The first contract, for construction of a portion of the earth embankment project, has been awarded to T. C. Cage and Dean Skinner, of Austin, Tex. Completion of the entire project is scheduled for 1953.

Modern Road Design Called Essential to Highway Safety

FATALITY RATES ON modern expressways are substantially below those on roads of earlier design, despite higher speed limits, Public Roads Commissioner Thomas H. MacDonald, Hon. M. ASCE, declared in the second annual Beecroft Memorial Lecture, delivered at a recent meeting of the Society of Automotive Engineers. Speaking as the recipient of the second Beecroft Memorial Award of the SAE "for outstanding service to highway safety," Mr. MacDonald emphasized the need for a long-range program of highway reconstruction. Such a program, he said, is fundamental to the traffic safety movement.

Among the principal hazards of existing roadways, he listed under-capacity for the traffic load, inadequate shoulders, dangerous curvature, inadequate sight distance, narrow lanes, congested road intersections, and railroad-highway crossings at grade. Nearly half of all rural highways carrying 1,000 or more vehicles per day are now less than 20 ft wide, he pointed out. "With one vehicle disabled on the average for every 20,000 vehicle miles of travel, wide shoulders and the removal of obstacles from the side of the pavement are of major importance.

"While higher speeds increase the severity of accidents, yet modern-type highways with the best safety records are accommodating traffic speeds definitely above those found on roads of inferior design. Safe vehicle speed depends in large measure upon characteristics of the roadway. Speed zoning is a practical solution of the problem if the signing is realistic enough to possess considerable self-enforcing value."

Commenting on the need for more adequate farm-to-market roads, Mr MacDonald stated that they must be designed specifically for use by trucks, with emphasis on low grades and good alignment. In view of the constantly increasing percentage of commercial vehicles in the traffic stream, he advocated provision of loading and unloading facilities off the main line of movement. Loading bays and terminals for trucks, if efficiently designed, serve a similar purpose, he said, particularly in metropolitan areas.

In stressing the importance of safe-vehicle maintenance, Mr. MacDonald urged a more stringent enforcement policy on brake maintenance. Better driver vision of the right-hand edge of the road also was suggested, together with "protective bumpers, front and rear, capable of absorbing shock, in place of expensive grillage."

Concluding that "our principally used street and highway systems are largely the product of the past one-third century," Mr. MacDonald stated that, "Most of the improved mileage has been built under public pressures, and legislative edict, to stretch the dollars over maximum lengths. We have now reached the point in our knowledge of the manner in which highways are used to correlate driver behavior under prevailing traffic conditions with the geometric details of highway design. The degree to which the criteria so determined are accepted and intelligently applied will determine the degree of safe efficiency of our future highways."

Bid Calls on Western Projects Announced by Bureau of Reclamation

UNDER THE HEADING of "Bid Calls Expected This Month," the Bureau of Reclamation's *Advance Construction Bulletin* for December 1 announces work about to go forward on several large projects in Western States. According to the bulletin, all information published is subject to revision, but the data given will serve as a guide to the nature, size and location of the proposed construction.

CANAL
Columbia Basin Project, Washington

Location: Near Ephrata, Wash.

Work: Construction of earthwork, concrete lining, and structures for about 14 miles of West Canal.

Excavation (common)	2,561,000 cu yd
Excavation (rock)	1,439,000 cu yd
Concrete in structures and lining	146,000 cu yd
Furnishing and handling cement	219,000 bbl
Furnishing and placing reinforcing steel	3,120,000 lb
Erection and installation of miscellaneous metalwork	327,000 lb
Time Allowed for Completion:	900 days

EARTHFILL DAM
Columbia Basin Project, Washington

Location: About 2 miles southwest of Coulee Dam, Wash.

Work: Construction of North Dam, an earthfill structure approximately 94 ft in height above stream bed and 1,350 ft long, and relocation of 1¼ miles of standard gage construction railroad. The dam is to form the north barrier of the Grand Coulee equalizing reservoir.

Excavation (all classes)	1,245,000 cu yd
Earthfill in embankment (all classes)	1,191,000 cu yd
Placing riprap	26,000 cu yd
Furnishing and placing reinforcing steel	80,000 lb
Concrete in footings and structures	1,400 cu yd
Time Allowed for Completion:	600 days

CONCRETE DIVERSION DAM
Missouri River Basin Project, Nebraska

Location: On the Republican River 2.5 miles west of Guide Rock, Nebr.

Work: Construction of Superior-Courtland Diversion Dam, a 300-ft-long concrete gravity overflow structure, and construction of earthwork and structures for about ¼ mile of the Superior Canal.

Excavation	219,000 cu yd
Compacting dike	139,000 cu yd
Riprap	13,000 cu yd
Concrete	10,000 cu yd
Furnishing and handling cement	15,000 bbl
Seeding	400,000 sq. ft
Furnishing and placing reinforcing steel	572,000 lb
Installing gates and hoists	53,000 lb
Time Allowed for Completion:	500 days

CANAL
Columbia Basin Project, Washington

Location: Near Coulee Dam, Wash.

Work: Construction of earthwork, concrete lining, and structures for about 1.5 miles of the 16,000-cfs-capacity Feeder Canal.

Excavation (all classes)	401,200 cu yd
Backfill	461,700 cu yd
Concrete in structures and lining	55,000 cu yd
Placing reinforcing steel	6,584,000 lb
Furnishing reinforcing steel	4,584,000 lb
Furnishing and placing metal waterstops	117,800 lb
Furnishing and installing equipment	160,000 lb
Time Allowed for Completion:	600 days

CANAL ENLARGEMENT
Paonia Project, Colorado

Location: Near Somerset, Colo.

Work: Enlargement of about 4 miles of Fire Mountain Canal (from its present capacity of 70 cfs to a capacity of 200 cfs), involving earth and concrete linings, and construction of diversion dam.

Excavation for canal	62,000 cu yd
Excavation for diversion dam and channel improvement	7,500 cu yd
Concrete	2,000 cu yd
Furnishing and placing reinforcing steel	300,000 lb
Time Allowed for Completion:	500 days

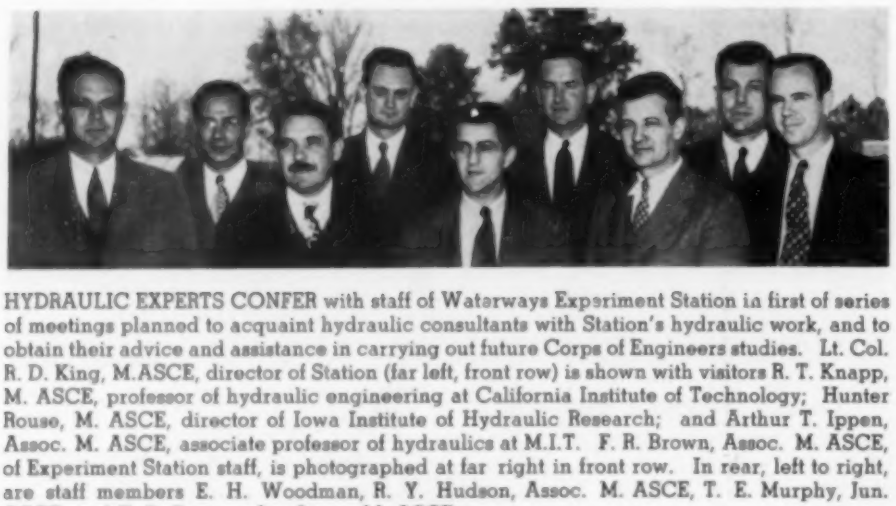
CONCRETE PIPE LATERALS
All-American Canal, California

Location: Near Coachella and Thermal, Calif.

Work: Construction of earthwork, pipelines, and structures for about 90 miles of laterals and sublaterals for Unit No. 6 of the Coachella Valley distribution system.

Excavation	378,000 cu yd
Concrete in structures	1,160 cu yd
Furnishing and laying 10- to 72-in. dia precast-concrete pipe	90 miles
Time Allowed for Completion:	450 days

Consultants to Waterways Experiment Station Meet at Vicksburg



HYDRAULIC EXPERTS CONFER with staff of Waterways Experiment Station in first of series of meetings planned to acquaint hydraulic consultants with Station's hydraulic work, and to obtain their advice and assistance in carrying out future Corps of Engineers studies. Lt. Col. R. D. King, M.ASCE, director of Station (far left, front row) is shown with visitors R. T. Knapp, M. ASCE, professor of hydraulic engineering at California Institute of Technology; Hunter Rouse, M. ASCE, director of Iowa Institute of Hydraulic Research; and Arthur T. Ippen, Assoc. M. ASCE, associate professor of hydraulics at M.I.T. F. R. Brown, Assoc. M. ASCE, of Experiment Station staff, is photographed at far right in front row. In rear, left to right, are staff members E. H. Woodman, R. Y. Hudson, Assoc. M. ASCE, T. E. Murphy, Jun. ASCE, and E. P. Fortson, Jr., Assoc. M. ASCE.

Positions Announced

U. S. Civil Service Commission. An examination for Physical Science Administrator for positions in Washington, D. C., and vicinity, paying $5,232 to $10,305, has been announced by the U. S. Civil Service Commission. To qualify, applicants must have completed a four-year college course with a physical science, mathematics, or engineering major or have had four years of technical experience in one of these fields, or a four-year combination of the two, plus three years of appropriate professional experience. Applications will be accepted until further notice by the Civil Service Commission, Washington 25, D. C., or regional offices of the Service.

U. S. Public Health Service. Reserve commissions and civil service appointments in the Public Health Service may be applied for until further notice by qualified sanitary engineers, biologists, bacteriologists, and chemists. The salaries for positions in the commissioned corps for those with dependents range from $3,391, Junior Assistant Grade (2nd Lt.) to $6,056.50, Senior Grade (Lt. Col.). These salaries will be higher for those with prior military service. The above positions may also be filled through civil service appointment. Positions of P-3 ($4,479.60 per annum) to P-7 ($8,509.50 per annum) are available for sanitary engineers, and up to P-6 ($7,432.20 per annum) in the other specialties. Further information may be obtained from the Chief, Division of Water Pollution Control, Public Health Service, Washington 25, D. C.

New Publications

Water Resources. Basic data obtained in cooperative studies of evaporation from water surfaces in California—made by the California State Division of Water Resources and the Division of Irrigation and Water Conservation of the U.S. Soil Conservation Service—are presented in Bulletin No. 54-A of the Department of Public Works. The present volume is essentially an expansion of Bulletin 54, *Evaporation from Water Surfaces in California*, which was issued in 1947. The late Arthur A. Young, Assoc. M. ASCE, was author of both bulletins.

Structural Design. In a 44-page publication entitled *Allowable Loads on Eccentrically Loaded Concrete Columns*, I. E. Morris, M. ASCE, has tabulated allowable loads for columns loaded eccentrically in a manner similar to that employed for concentrically loaded columns. It is claimed that these tables will permit the saving of many hours of time in the calculation of combined stressed in reinforced concrete columns. Copies may be obtained from the author, Box 788, Atlanta, Ga., at $2.50 each.

Engineering Research. An extensive

range of engineering research problems is covered in the twelve articles that comprise *The Pay-Off in Research*, recent publication of the Engineering College Research Council of the American Society for Engineering Education. The aim of the booklet is to show how industry and the general public, as well as college students and faculties, have benefited from the discoveries made in engineering college research. Copies may be purchased from the Engineering College Research Council, State University of Iowa, Iowa City, Iowa, at 50 cents each.

Water Works Operation. All phases of water purification processes are covered in *Manual for Water Plant Operators* by A. A. Hirsch, instructor in water purification, Sectional School on Water Supply and Sewerage, Louisiana State Department of Education. Latest developments in water technology and a comprehensive picture of correct operating practice are included in the 368-page volume, which sells for $6.50 plus postage. Orders should be sent to the Chemical Publishing Co., Inc., 26 Court Street, Dept. MJ, Brooklyn 2, N.Y.

Highway Equipment. *Who's Who in the Highway Industry*, a 208-page classified directory of the American Road Builders Association, includes a comprehensive listing of manufacturer members of the ARBA with their products and trade names; more than 700 classifications of construction and maintenance equipment and materials exhibited at the ARBA Road Show in Chicago in July; and 600 trade names, listed with company names to facilitate identification of each company's product. The directory may be purchased at $1 a copy from the ARBA, International Building, Washington 4, D. C.

Concrete Research. Experiments with air entrainment in cement concrete, conducted by the Kentucky Department of Highways and the College of Engineering at the University of Kentucky, are detailed in Bulletin No. 5 of the Engineering Experiment Station. Inquiries regarding the bulletin, which was written by L. E. Gregg, Assoc. M. ASCE, associate director of research for the Kentucky Department of Highways, should be addressed to the Engineering Experiment Station, University of Kentucky, Lexington 29, Ky.

R. Robinson Rowe, M. ASCE

THE JANUARY MEETING of the Engineers Club got off to a gloomy start—sort of a letdown after the rushes of world series, election, Xmas and Rose Bowl, with forebodings of war or a leftist world.

"Cheer up," chirped Professor Neare, "1949 is a prime year."

"So was 1933!"

"So you're in just the right mood to shove desks around narrow hallways. Joe, you tell them how large a desk can be turned from a 156-in. to a 65-in. corridor."

"Easy, Professor," replied Joe Kerr "A 156 × 65-in. desk could be shoved north into the intersection and then west into the narrow hall."

"That would be getting *by*, not *around*, the corner," objected Cal Klater. "In the figure, suppose we move desk $ABCD$ so that A and B slide along the outer walls. It rotates about an instantaneous center $P = (x, y)$ at the intersection of normals AP and BP. At the 'squeeze,' CD will graze the reentrant corner O, so that $OP \perp CD$, and we have from similar triangles:

$$x(a-x) = y(b-y) \quad (1)$$

$$(a-2x)dx = (b-2y)dy \quad (2)$$

To make the area of the desk a maximum, differentiate

$$uv = ab-xy \quad (3)$$

$$d(uv) = -xdy-ydx = 0 \quad (4)$$

Eliminating differentials from (2) and (4),

$$\frac{dy}{dx} = \frac{a-2x}{b-2y} = -\frac{y}{x} \quad (5)$$

$$2x^2 + 2y^2 = ax + by \quad (6)$$

Eliminating x from (1) and (6),

$$y(16y^3-24y^2 + 9b^2y + 3a^2y-2a^2b) = 0 \quad (7)$$

Fortunately, the cubic gives solutions to related problems, leaving $y = 0$ for this one. So $x = 0$, $uv = ab = 156.65$; then with AB the diagonal of the intersection, $u = 169$ and $v = 60$."

"That's right, Cal, and Joe, you had the right magnitude but the wrong shape. I'd like to assign some sequel problem, like interpreting the cubic in (7) or finding the envelope of CD, but we can have more fun with a worm race.

"Three worms, Slippy, Sloppy and Sluppy, slithered at constant speed down a 3-ft straightaway in the Vermithon Handicap. Slippy started with his nose on the mark, Sloppy with his nose at Slippy's heels, and Sluppy with his nose at Sloppy's heels. In 5 min Slippy nosed the halfway mark, and the other two were nose-and-nose 2 in. behind. Sluppy won by a length in 9 min flat, with Slippy at Sloppy's heels. How long is a worm?"

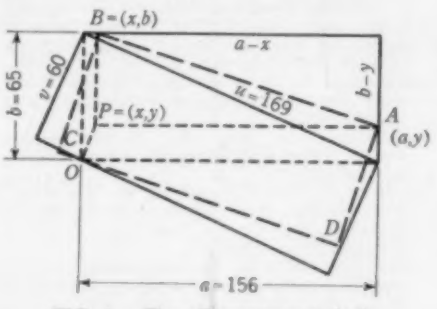


FIG. 1. The ell-passingest desk.

[Cal Klaters, some proving and some hunching that $x = y = 0$, were: Richard Jenney, John L. (Stoop) Nagle, George C. Stewart, Walter T. Wilson's daughter, the convalescent, Ann Othernut (J. Charles Rathbun), Ed C. Holt, Jr., Benjamin A. Wasil, W. D. Dickinson, Jr., and Homer W. Woodbury. Nagle and Wasil offered the simplest proofs that $x = y = 0$. Jenney characterized the envelope of AB as a hypocycloid and that of CD as a mean old hypocycloid-in-law. Holt and W. F. Sloan were finalists solving the October peanut problem.]

Meetings and Conferences

American Society of Heating and Ventilating Engineers. The 55th annual meeting of the American Society of Heating and Ventilating Engineers will be held at the Stevens Hotel, in Chicago, Ill., January 24–27. Five technical sessions have been scheduled, and subjects to be discussed are fuel and industrial ventilation, air distribution, radiant heating, and environmental conditions. This meeting will be held simultaneously with the ninth International Heating and Ventilating Exposition, at the International Amphitheatre.

Associated Equipment Distributors. More than 1,200 members of the Associated Equipment Distributors of the United States and Canada will convene at the Stevens Hotel, Chicago, Ill., January 16–20, for the association's annual meeting. This meeting marks the beginning of 40 years of service to the construction equipment industry. All registration requests and inquiries should be addressed to Frank G. Knight, executive secretary, Associated Equipment Distributors, 360 North Michigan Avenue, Chicago, Ill.

Concrete Industries Exposition. The sixth Concrete Industries Exposition will take place at the Cleveland Public Auditorium, Cleveland, Ohio, January 31 to February 3.

Louisiana Engineering Society. Technical sessions sponsored by local groups of the various engineering societies are scheduled for the Louisiana Engineering Society's annual meeting, which is to be held at the St. Charles Hotel, New Orleans, La., January 13–15.

Materials Handling Conference. A Materials Handling Conference, under the auspices of the American Society of Mechanical Engineers in conjunction with the Materials Handling Exposition, is to be held at Convention Hall, Philadelphia, Pa., January 10–14. Problems of practically all agencies and industries handling materials will be considered, including the Berlin Air Lift.

Society of Automotive Engineers. Headquarters for the annual meeting of the Society of Automotive Engineers will be the Hotel Book-Cadillac, Detroit, Mich., January 10–14.

Parallel Bridge Recommended for San Francisco Crossing

(*Continued from page 23*)

be completed for traffic by March 1954.

The parallel bridge offers no engineering problems that were not solved when the first bridge was built, the report stated. The designs are identical for the two structures. Foundation conditions are the same as for the present bridge. The main crossing would consist of twin suspension bridges placed end to end on each side of a common central anchorage. Suspended spans each would be 2,310 ft long. The new tunnel through Yerba Buena Island would be slightly longer than the one now in use. Completion of the parallel bridge would make possible one-way traffic on each structure, with five wide lanes for automobiles on the upper deck and two for trucks and buses on the lower deck of each bridge. Electric trains are not contemplated on the new parallel bridge.

The southern crossing studied—a combination of causeway and triple tubes under the navigable channel of the bay and a double tube under Oakland Estuary—presents new engineering problems. The subaqueous section under the bay would consist of three two-lane precast concrete tubes 37 ft in outside diameter terminating in artificial sand islands 3,000 ft apart. The tubes under Oakland Estuary would be similarly built but would not include artificial islands. Individual tubes would be sunk with the joints between adjacent tubes resting on precast slabs positioned on timber piles cut off to grade under water. Dredged excavation and fill of over 21,000,000 cu yd would be required to remove the mud under the tubes, to replace the mud with sand, and to build the sand islands.

Each of the 101 tube sections is designed for a length of 200 ft and a weight of over 5,000 tons. Trucks, autos, and buses would be mixed together in the same lanes in the southern crossing. Ventilating buildings are planned at each of the sand islands. The tubes would be sunk and backfilled with their tops 50 ft below the bay level to provide a clear navigation channel 1,500 ft wide. Figure 2 shows a cross section of the tubes.

Experienced military personnel conclude that the destruction of both parallel bridges by any bomb now known is not possible, except by an improbable close hit by an atomic bomb.

The following group of national authorities acted as engineering consultants to the Division: George L. Freeman, M. ASCE, of Moran-Proctor-Freeman & Mueser, New York, on bridge foundations; Ralph Smillie, M. ASCE, Chief Engineer, New York Triborough Bridge and Tunnel Authority, on subaqueous tubes; O. J. Porter, M. ASCE, of O. J. Porter & Co., New York and Sacramento, on soil testing and stabilizing problems; George Burpee, M. ASCE, of Coverdale & Colpitts, New York, on traffic, revenue, and financing. Key personnel in the office of the Division are Norman C. Raab, M. ASCE, Design Engineer of Bridges; Oliver R. Bosso, Assoc. M. ASCE, Engineer of Surveys; and Edwin F. Levy, Assoc. M. ASCE, Office Engineer.

Formula for Velocity at Beginning of Bed-Load Movement

(*Continued from page 39*)

is encouraging, as shown in Figs. 2 and 3.

How (qualitatively) and how much (quantitatively) should estimates of competence be modified for the following conditions:

If the streambed is sloping or undulating.

If the bed material is cemented or if it is non-granular.

If the water is turbid and is transporting colloidal material, suspended matter, or bed load.

If the flow is non-uniform but quasi-regular, or if it is "turbulent."

If the flow is unsteady.

These conditions, and doubtless many others, may need to be investigated before the phenomena of competence are fully catalogued. Then, perhaps, in the spirit of Newton's "Rule 4" the propositions induced herein "may be made either more accurate—or liable to exceptions."

This article was originally presented before the meeting of the International Association for Hydraulic Structures Research, Stockholm, Sweden, June 7–9, 1948.

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Evaluation of Travel Habits for Boston Expressway Plan

(*Continued from page 22*)

the land to be affected by right-of-way acquisition could result in such growth and expansion that values would reach prohibitive proportions. One way to protect the state's rights would be to make immediate takings of all properties to be involved. Such a procedure would obviously be impracticable since the necessary expenditures would unbalance the entire financial plan and upset the stage construction program.

As an alternative, a policy of development control could be established, whereby the state would immediately define the right-of-way lines, but postpone actual takings until necessary for construction. Under such an arrangement land would remain in private ownership with the provision that its existing use may be continued by the owners, but that no change in use, no improvement, and no subdivision would be allowed without official approval.

This action would naturally raise the objection that undue hardship was being imposed upon property owners by restricting the free development of their holdings. This objection could be met by proper reimbursement of the owners for the limitation of use and occupancy.

The preparation of the master plan was, to all those concerned, a very interesting and worthwhile task. Although the consultants were given a free hand and proceeded without any influence or the injection of any preconceived ideas by the Joint Board, the state engineers were nevertheless very much gratified to learn that the findings of the consultants, based solely on factual data, conformed in many cases to previous proposals of the Department of Public Works for highway improvements in the metropolitan area.

As to the present status of the master plan, a bill introduced during the 1948 legislative session provided for a bond issue of $100,000,000 as a start on the state-wide highway program which, including the metropolitan projects, will total about $700,000,000. The bill did not pass but it is hoped that it will go through next year. In the meantime, work is proceeding on some of the essential projects. As previously mentioned, the Mystic River Bridge construction is under way. Excavation work on the East Boston Express Highway has been started and construction plans for the second traffic tunnel are progressing.

Contractor Meets Tolerances in Building Concrete Arch Bridge

(*Continued from page 43*)

strength was 590 psi, and the modulus of elasticity varied from 2,850,000 to 4,500,000 psi.

Conclusions Drawn from Tests

Two conclusions were drawn from the tests: (1) The elastic deformations found by applying the 40-ton load separately on each side of the arch were practically the same, thus proving the uniformity of materials and workmanship. (2) The measured elastic deformations were considerably lower than calculated on the basis of specifications which assume that the modulus of elasticity is 3,000,000 psi and the ratio n equal to 10.

The maximum elastic deflection was 0.046 in., only 17 percent of the calculated value of 0.275 in. The center line was raised 0.046 in., or 20.7 percent of the calculated value of 0.22 in. To arrive at a better conformity between measured and calculated values, it would be necessary to increase the modulus of elasticity to 4,950,000 psi, and to increase the ratio n from 10 to 22.5. Under these conditions the actual deformations would still be but 25 and 30 percent respectively of the calculated values, which shows that there were other factors involved, probably a different degree of restraint at the springing points from that assumed in the calculations.

Stresses in the concrete, both in compression and in tension, as determined from the measurements, were lower than those calculated with the modulus of elasticity at 3,700,000 psi, assuming homogeneous sections. Only in sections where the spandrel arches rest on the main arch was conformity found between the measured and calculated values. This result can be explained by the fact that these sections were more strongly reinforced than other portions of the arch and consequently carried a greater amount of loading than was assumed in the analysis.

Spandrel Arches Poured

Summarizing, the results of the loading test were entirely satisfactory, and the contractor was directed to complete the bridge. The spandrel arches were concreted in the period from November 14 to 22, 1940, care being taken to exactly balance the loads on both sides of the arch. The closing sections were poured on November 27, 1940. The steel trusses of the centering were removed after three weeks, on December 17, 1940. The reason for this early removal was the freezing weather, as it was feared resulting contraction of the tie-bars (0.6 in.) would damage the base plates of the steel form arches and endanger removal of the centering, with consequent cracking of the concrete. The measured settlement of the spandrel arches after removal of the centering was 0.22 and 0.16 in. respectively as compared with the calculated value of 0.265 in. Simultaneously, the main arch rose 0.218 in. at the crown.

The design of the Podolsko Bridge over the Vltava River has been recognized as an outstanding achievement in bridge enginering. The bridge was awarded the Grand Prix at the International Exposition in Liége, Belgium in 1939, with recognition to the planning and designing engineers, Antonín Brebera and Jan Blažek.

Utilidors Protect Service Pipes from Freezing

(*Continued from page 29*)

In order to compare typical utility systems for a military base and a civilian community, studies have been made for systems including sewer and water facilities but not steam distribution, for a community of a size similar to the previous one. As the steam mains are no longer available as a source of heat, a small 75-hp boiler plant is included in the design, furnishing heat through a small steam line known as a tracer, laid in the utilidors. The sectional area of the utilidor structure is reduced in the absence of the bulky steam mains and will now vary from a maximum size of 3 ft × 3 ft 6 in. down to 2 ft × 1 ft 6 in. The system is otherwise identical with the utilidor previously discussed.

The conventional or buried pipe installation also has a small boiler plant included in the design. The water supply is heated at the source and is kept circulating by pumping. Sewers are kept from freezing by bleeding warm water into the sewer service pipes. The pipes are laid in the frozen ground with no special insulation against frost.

Costs Compared

Costs of both systems have been compared as before and are shown also in Table I, under Plan II. In this instance the first cost of the utilidor system is more than twice that of the conventional installation, and annual service costs differ but little, the utilidor system enjoying a slight advantage because of the higher annual operating cost of the conventional installation. From a practical point of view this slight difference is insignificant. However, there is no question as to the advantage held by the conventional installation in the matter of initial cost.

When to Choose Utilidor System

We may conclude then that the utilidor system is a more practicable installation than the conventional type of utilities system for a community such as a permanent arctic military base where all utilities, including central heat, are supplied by a single agency, and for arctic municipalities financially able to provide central steam distribution.

The conventional system is the more suitable type for small communities financially unable to provide a central steam plant; however, this type of system is more vulnerable to operational difficulties.

Acknowledgment is made to the Corps of Engineers, Department of the Army; and to the staff of Fay, Spofford and Thorndike, particularly H. H. Jones and W. F. Converse, for assistance in the preparation of this article.

Cost Control Shows Efficiency of Men and Machines

(*Continued from page 17*)

immediate and direct pattern for the classification of accounts. This practice would also remove one of the major factors entering into the unbalancing of bids, namely the need of obtaining funds as early as possible for the purpose of financing. Indeed, if the construction plant could be included in the bid items, the contractor would be required to make a much smaller investment in the job since progress payments during early stages would come sooner and would be larger.

We have been advised by the Assistant Commissioner of Reclamation, Kenneth Markwell, M.ASCE, of some of the operations of its recently organized Office of Programs and Finance. The Bureau of Reclamation is to be congratulated on its pioneering in the field of systematic, uniform cost control methods and particularly for moving from the discussion stage to the actual execution of a practical plan. Contractors will be the ultimate beneficiaries of these efforts.

Deceased

Percy Canfield Barney (Assoc. M. '01) civil engineer of Brooklyn, N.Y., died on July 28, according to word just received at Society Headquarters. His age was 77. Beginning in 1908, Mr. Barney was for many years principal assistant engineer for the New York Board of Water Supply. Later he was assistant engineer in the Borough President's Office, and more recently had been in the New York City Department of Planning.

Henry Lee Bowlby (M. '25) civil engineer of Chicago, Ill., died on November 7, at the age of 68. A pioneer in road construction in the Pacific Northwest, Mr. Bowlby served as highway commissioner for the State of Washington, and as state highway engineer for the newly established Oregon State Highway Department. After service overseas in World War I, with the rank of lieutenant colonel, Mr. Bowlby became senior highway engineer for the U.S. Bureau of Public Roads (now the Public Roads Administration). Later he was chief engineer of the Long Island State Park Commission, and from 1932 to 1939 president of the National Concrete Service Corp., Chicago.

Harold Mahlon Fish (Jun. '44) ensign, U.S. Naval Reserve, was killed in an airplane crash near Athens, Greece, on October 19. Mr. Fish was 26, and a civil engineering alumnus of Tufts College, class of 1944. His home was at Beverly, Mass.

George Frederick Lovett (Assoc. M. '04) engineer for Brown Co., of Berlin, N.H., died recently at the age of 73. A specialist in the design and construction of paper and pulp mills, Mr. Lovett had been in charge of the planning and building of such structures in Maine and New Hampshire and at Glens Falls, N.Y. He had built a hydroelectric plant for the Berlin Shelbourne Power Co. and a filtration and clarification plant for the City of Berlin. For several years he was city engineer of Berlin.

Harold Douglas Van Vranken (M. '47) chief engineer for the Jacksonville Terminal Co., Jacksonville, Fla., died suddenly at his home there on November 20. He was 50.

H. D. Van Vranken

From 1922 to 1936 Mr. Van Vranken was with the Pennsylvania Railroad in various engineering capacities. Later (1942 to 1945) he was assistant division engineer for the Seaboard Airline Railroad, in charge of construction and maintenance of water stations in north Florida, and in September 1945 he became chief engineer for the Jacksonville Terminal Co. Mr. Van Vranken had been active in the Florida Section, and served as president in 1947 when the Section was host to the ASCE Fall Meeting.

George Richardson Harlow (M. '99) retired engineer of Cleveland, Ohio, died on August 21, 1946, according to word just received at Society Headquarters. He was 89. Mr. Harlow had been employed on water investigations for the state of Pennsylvania, and laid out a plant for the Sinclair Refining Co. at Marcus Hook, Pa. At the time of his retirement in 1926 he was inspector of municipal improvements for the City of Cleveland Heights, Ohio.

Charles Shedd Howe (Assoc. M. '31) vice-president and technical director of the Los Angeles Technical Laboratory, Los Angeles, Calif., died recently. Mr. Howe, who was 51, had been with the Laboratory since 1921. His work during this period included supervision of laboratory tests and engineering surveys for numerous municipal, county, state, and private construction projects and improvements. Earlier in his career he was with the Chemical Warfare Service in Washington, D.C.

Frederick Charles Herrmann (M. '07) consulting engineer of San Francisco, Calif., died on October 27, at the age of 78. Before entering private practice in 1914, Mr. Herrmann had served, successively, in the San Francisco city engineer's office; as irrigation and drainage engineer in the Rocky Mountain area; and as chief engineer for the Imperial Valley Irrigation District and the Spring Valley Water Co. He had served as a consultant on appraisal of all properties acquired for the Central Valley Project. Long interested in ASCE affairs, Mr. Herrmann served as Director from 1931 to 1933.

Robert Gilbert Martin (M. '42) civil engineer of Beverly Hills, Calif., died on November 1, at the age of 58. From 1921 to 1925 Mr. Martin was in charge of surveying and construction for the Beverly Hills Realty Co., and from 1925 to 1928 in private practice as a surveyor and civil engineer. From 1928 to 1937 he was with the Bureau of Water Works and Supply for the City of Los Angeles, in charge of foundation tests for the Boquet Canyon Dam and Grant Lake Dam and construction of the Mono Crater Tunnel.

Alexander Howard Nelson (M. '15) former county engineer for Atlantic County, New Jersey, died in Atlantic City, N. J., on November 21, at the age of 74. After working as a designer and construction engineer in Pittsburgh for ten years, Mr. Nelson went to Atlantic City in 1907 to serve on the construction of bridges and boulevards. Becoming county engineer in 1913, Mr. Nelson continued in that position until ill health forced his retirement in 1947. He had also served on the engineering staff of the South Jersey Transit Commission.

George Frederick Roehrig (Assoc. M. '20) associate professor of civil engineering at Lafayette College, Easton, Pa., died suddenly on November 10. Professor Roehrig, who was 62, was on the faculties of Pennsylvania State College and Oklahoma Agricultural and Mechanical College before going to Lafayette in 1928. In the first World War, he served as a captain in the Field Artillery.

Brent Skinner Drane (M. '13) hydraulic and civil engineer of Chapel Hill, N.C., died in a hospital in Durham on November 21. Mr. Drane, who was 67, was a former member of the National Resources Planning Board and had served as secretary and office coordinator for the drainage basin study of the National Resources Committee in 1936. Mr. Drane was at one time North Carolina State geologist and director of the North Carolina Geological and Economic Survey, and more recently had been principal engineer for the War Production Board in Washington, D.C. Retiring from government service about two years ago, he was recently recalled as a member of the panel on hydrology of the Committee on Geophysical Sciences of the Research and Development Board of the War Department.

Brent S. Drane

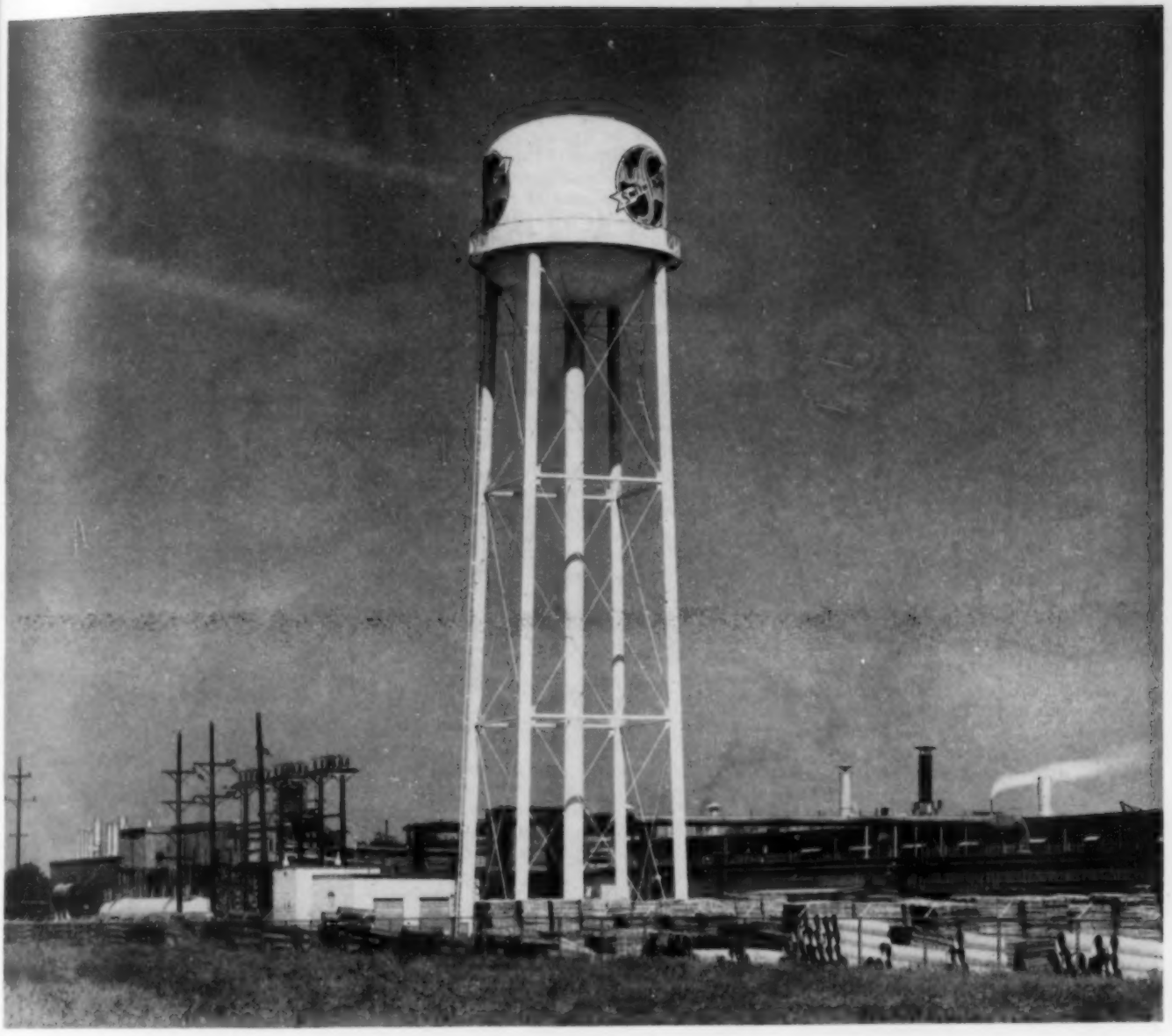
Ralph Dennis Rader (M. '22) manager of the Portland Cement Information Bureau, San Francisco, Calif., died in Berkeley, Calif., on November 12. Mr. Rader, who was 62, spent a number of years with the Montana State Highway Department—as state highway engineer from 1928 to 1935, and bridge engineer in 1935 and 1936. In World War I, he served with the Engineers Corps overseas, with the rank of major, and during the recent war he constructed highways and railroads for Camps Roberts and Cook in California. For the past several years he had been manager and consulting engineer for the Portland Cement Information Bureau.

Isidor Dorr Raffin (M. '43) vice-president and chief engineer of Barrett & Hilp, San Francisco construction firm, died in that city on November 8. He was 58. With the firm since 1926, Mr. Raffin had supervised its work on the buildings of both the Golden Gate and San Francisco-Oakland Bay bridges. During World War II, he was in charge of the construction of 5,000 houses in Portsmouth, Va., built by Barrett & Hilp as part of the government's war housing program.

George Loyal Sawyer (M. '20) of Summit, N.J., died there on December 1, at the age of 67. Mr. Sawyer spent his early career in railroad work and in the design and construction of sewage disposal facilities. From 1906 to 1908 and from 1911 to 1919, he was a partner in the engineering firm of Sawyer Brothers, with headquarters in Seattle and Spokane. Later he served as sales manager for the Barber-Greene Co., of Aurora, Ill., and secretary of the National Association of Finishers of Textile Fabrics. He retired about six years ago.

George Herbert Shaw (M. '22) senior architectural engineer for the U.S. Department of Agriculture, Washington, D.C., died suddenly on November 4. He was 67. Before going to the Department of Agriculture in 1930, Mr. Shaw was district engineer for

(Continued on page 76)



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A Horton elevated tank and an automatic sprinkler system are your most dependable defense against fire. They start to fight back just as soon as a fire breaks out, before it has a chance to spread. They go to work at the heart of a fire, where fighting is most effective, and which often cannot be reached by any other fire-fighting method. A sprinkler system, backed by an elevated tank, may mean the difference in your plant between a few minutes' interruption and a costly shutdown.

Horton ellipsoidal-bottom elevated steel tanks are built for use with automatic sprinkler systems and for general industrial service in capacities from 40,000 gals. to 500,000 gals. As a result of their butt-welded steel construction, they are smooth, graceful structures which can be maintained economically. All parts of the tanks are accessible for inspection and painting.

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Los Angeles 14.....1456 Wm. Fox Bldg.
New York 6.....3395-165 Broadway Bldg.
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Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

(*Continued from page 74*)

the Clay Products Association, with headquarters in Philadelphia. Earlier in his career he had been, successively, assistant engineer for the New York City Board of Water Supply; sanitary engineer for the Department of Agriculture; sanitary engineer for the U.S. Shipping Board; and chief of the Division of Housing and Sanitation of the Philadelphia Department of Public Health.

George Perry Steen (Assoc. M. '48) associate professor of civil engineering at the University of New Mexico, Albuquerque, N.Mex., died recently. He was 36. A George Perry Steen Memorial Engineering Fellowship for needy and deserving students majoring in engineering is being established in his honor at the University of New Mexico, where he had taught since 1943. Before joining the faculty there, he had been on the staff of the Texas School of Mines and worked on the design and construction of several large buildings for the Twin City Ordnance Plant at New Brighton, Minn. At the time of his death Professor Steen was president of the New Mexico Society of Professional Engineers.

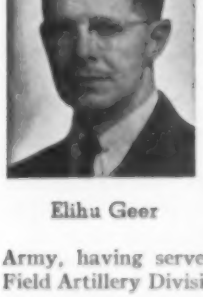
Alfred Alexander Visintainer (M. '48) engineer of structures for the Erie Railroad, Cleveland, Ohio, died on September 27, 1948. Mr. Visintainer, who was 44, had been with the Erie Railroad since his graduation from Lehigh University in 1926. He became engineer of structures in 1947.

Wayne Wellington Wyckoff (Assoc. M '31) engineer for the Los Angeles Department of Water and Power, in charge of the Los Angeles Aqueduct, was killed in an automobile accident on October 27. Mr. Wyckoff, who was 46, had served the Department of Water and Power in various capacities since 1925. From 1937 to 1941 he was resident engineer on construction of the Mono Basin Project, and since 1941 had been on the operation and maintenance of the Los Angeles Aqueduct.

NEWS OF Engineers

John B. Wilbur, head of the department of civil and sanitary engineering at the Massachusetts Institute of Technology, has become affiliated with the Boston engineering firm of Fay, Spofford & Thorndike in a consulting capacity. He will assist particularly on complex structural engineering problems.

Elihu Geer, acting director of the department of civil engineering, University of Detroit, has been appointed to command an Army-established Organized Research and Development Group at Detroit, to originate a reserve officers training program for maximum utilization of the abilities of professionally and scientifically trained men. Professor Geer was a colonel in the U.S. Army, having served five years with the Field Artillery Division.



Elihu Geer

Carl L. Torrence announces the opening of a structural engineering office under his own name at Richmond, Va. Mr. Torrence was formerly director of real estate and engineering services for Southern States Cooperative, Inc., in the same city.

Clifford S. Strike, president of the Hartford, Conn., firm of F. H. McGraw & Co., and head of Overseas Consultants, Inc., New York City, has gone to Iran to initiate a preliminary economic and social study in connection with that country's $650,000,000 development program.

P. H. McGauhey, formerly professor of sanitary engineering at Virginia Polytechnic Institute, Blacksburg, Va., is now a visiting professor of civil engineering at the University of Southern California. Professor McGauhey was at V.P.I. for the past 21 years.

Harry Larson has opened an office for the practice of engineering in the Cooper Building, Denver, Colo., where he will specialize in water works, sewerage, irrigation and drainage. Mr. Larson served as a major in the Corps of Engineers during the second world war.

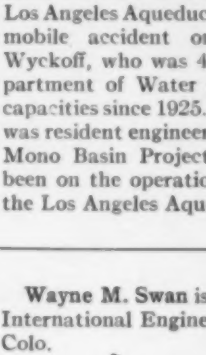
Jack R. Benjamin, formerly assistant professor of structural design at Renssalaer Polytechnic Institute and more recently assistant professor of civil engineering at Stanford University, has been appointed full professor on the faculty of the Stanford School of Engineering.

Montague A. Craven has accepted a position with the newly formed New Zealand Portland Cement Association, with headquarters in Wellington. During World War II, Mr. Craven served as a lieutenant of the New Zealand Field Engineers, and he recently toured the United States and Canada, under a New Zealand Government Traveling Scholarship.

SILVER STAR MEDAL is pinned on Maj. Stanley R. Navas, Jun. ASCE, 1941 graduate of Virginia Military Institute and Junior Contact Member for Student Chapter, by VMI superintendent at special review in his honor during recent Homecoming Day exercises. Major Navas, now with Concrete Pipe & Products Co., Richmond, was honored for outstanding services with his paratrooper outfit in bitter fighting in Italian campaign.

Wayne M. Swan is now affiliated with the International Engineering Co., at Denver, Colo.

Frank Charles Mirgain, previously professor of civil engineering at Rutgers University, has been appointed head of the civil engineering department at the Cooper Union School of Engineering. Professor Mirgain has been on the Rutgers faculty since 1931. He is a specialist in municipal engineering and sanitation, and has served as resident engineer on the construction of the Rutgers Stadium during 1937 and 1938, and as materials engineer for the Indiana Highway Commission.



F. C. Mirgain

A. S. Marvin, since 1947 assistant division engineer of the American Bridge Co., Pittsburgh, Pa., is now division engineer in charge of the engineering department of that company, succeeding **F. S. Merrill,** who will be assigned to special engineering projects.

Kenneth C. Reynolds, professor of general engineering at the University of Southern California, has been appointed to head the department of general engineering. Dr. Reynolds previously served as head of the Cooper Union civil engineering department and, prior to that, was on the staff of the Massachusetts Institute of Technology.

Humberto J. Benet has been granted a scholarship by the Institute of International Education to do graduate work toward a master's degree in civil engineering at the University of Florida.

R. D. Goodrich, dean emeritus of the University of Wyoming College of Engineering, is the recipient of the Sigma Tau annual award for "valued contribution to engineering education." The presentation of the gold medal accompanying this honor was made at a recent meeting of the fraternity by Dr. A. G. Crane, Secretary of State for Wyoming and former president of the university.

(*Continued on page 77*)

(*Continued from page 76*)

Milner W. **Carley** has resigned from the post of principal assistant engineer in the county surveyor's office in St. Paul, to open a consulting engineering office in St. Paul, Minn. For nearly 26 years, Mr. Carley has been associated with the surveyor's office, where he was responsible for important county engineering projects, and prepared a five-year improvement program for rural county highways.

George H. **Canfield,** who has for the past 20 years been district engineer of surface-water investigations for the U.S. Geological Survey, at Portland, Ore., is retiring. Mr. Canfield will be succeeded by **Kenneth N. Phillips,** affiliated with the Geological Survey for more than 28 years and a member of many committees directed toward the development of water resources of the State of Oregon.

Jehiel H. Lehman and **Samuel Schultz** have established offices for the practice of civil engineering at 8844 Olympic Boulevard, Beverly Hills, Calif. They will specialize in the design of commercial and industrial buildings.

George H. Knutson has been appointed chief of the Machinery and Equipment Branch and executive chairman of the Projects Committee in the Industry Division of the Economic Cooperation Administration. Prior to this appointment, Mr. Knutson was vice-chairman of the Army Price Adjustment Board, administering the Renegotiation Acts for the removal of profits made by contractors on the production of war materials for the Army. He was honored by the Secretary of War in June 1946 with the Emblem for Exceptional Civilian Service.

Fred H. Waring, chief of the sanitary division of the Ohio State Department of Health at Columbus, has been selected to receive the Fuller Award for 1948 in recognition of his outstanding services to the public in the field of water supply and sanitary engineering. This award, made annually by the American Water Works Association, will be presented to Mr. Waring at the association's spring meeting in Chicago, Ill.

Fletcher Pearce has recently been promoted from the rank of associate professor to that of professor of engineering at the Northern Montana College, Havre, Mont.

John W. Doty, president of the Foundation Co., New York City, has been elected vice-president of the board of trustees at Renssalaer Polytechnic Institute. As president of the Foundation Co., Mr. Doty has directed large-scale construction projects in the United States and abroad.

John C. Evans, chairman of the engineering board of the Port of New York Authority, and **John M. Kyle, Jr.,** chief engineer, recently made an inspection tour of European air terminals and seaports.

J. C. Witt, technical director of the Chicago, Ill., office of the Marquette Cement Manufacturing Co., is now consulting engineer for that firm. At one time Mr. Witt directed the research for Universal Portland

(*Continued on page 80*)

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Based on the findings of a survey conducted by leading water works engineers.

CAST IRON PIPE

(Continued from page 77)

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when the qualifying gas or water main is taken out of service, or, sold for re-use.

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THE HARTFORD GAS COMPANY
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BUREAU OF WATER
Lancaster, Pennsylvania

LOUISVILLE GAS & ELECTRIC CO.
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CITY OF LYNCHBURG WATER DEPARTMENT
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MOBILE GAS SERVICE CORP.
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NEW ORLEANS PUBLIC SERVICE, INC.
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Saving Ways in Doorways
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(*Continued from page 77*)

Cement Co. (now Universal Atlas Cement Co.).

Dr. Theodore von Karman, director of the Guggenheim Aeronautics Laboratory at the California Institute of Technology, has been appointed an honorary professor of mechanical engineering at Columbia University. The distinction, rarely conferred by the University, is in recognition of his outstanding achievement in the field of aerodynamics.

Sigvald Johannesson, designer of the Pulaski Skyway in north New Jersey, has retired from the New Jersey State Highway Department after approximately 25 years of service. His accomplishments include the development of the idea of moving concrete pavements sideways with compressed air to widen Route 26 (New Brunswick Pike).

Harry H. Stahl, assistant chief engineer, Belmont Iron Works, Philadelphia, Pa., has been made chief engineer. **Robert E. Seiffert,** structural engineer, and **Bennett F. Mial,** manager of construction for the organization, have been elected to the board of directors and finance committee, respectively.

Donald M. Newman, formerly assistant highway engineer for the New Jersey State Highway Department at Perth Amboy, N.J., has been named head of the Monmouth Council of the New Jersey Civil Service Association. In this capacity, Mr Newman will be in charge of a 500-member council of municipal, county, and state civil service workers residing in Monmouth County, New Jersey.

Pierre Danel, director of the largest hydraulic laboratory in Europe, maintained by the Neyrpic Co., of Grenoble, France, is visiting this country, where he is investigating American methods of dam construction, and hydraulic laboratory techniques. In addition to his connection with the Neyrpic Laboratory, where French and U.S. Army engineers cooperated during the war in model studies of the Rhine River that aided in the invasion of Germany, Professor Danel is also director of the Laboratory of Hydraulic Study and Research of the Grenoble School of Hydraulic Engineering and editor of the French hydraulics magazine, *White Coal*.

Alfred Hedefine is now with the New York consulting firm of Parsons, Brinckerhoff, Hall & Macdonald. Until recently he was on the staff of Hardesty & Hanover, New York City consultants.

Louis J. Cappozoli, Jr., of New York City, is studying for a doctor of science degree from Massachusetts Institute of Technology. Although only 20 years old, Mr Cappozoli already holds two degrees—a B.C.E., cum laude, from New York University, and a S.M. in C.E. from Harvard University. He was recently elected a Junior in the Society. While at New York University, he served as president of the Student Chapter.

Recent BOOKS

A.S.T.M. Standards on Mineral Aggregates, Concrete, and Nonbituminous Highway Materials. Specifications, Methods of Testing, Definitions. American Society for Testing Materials, Philadelphia 3, Pa., 1948. 189 pp., illus., diagrs., tables, 9 × 6 in., paper, $2.25. This new compilation presents some 70 standards, test methods, and specifications covering a wide range of materials and methods. It also includes pertinent specifications on cement, brick, and block pavement materials, and miscellaneous chemicals of use in the field.

Business, Legal, and Ethical Phases of Engineering. By D. T. Canfield and J. H. Bowman. McGraw-Hill Book Co., New York, Toronto, London, 1948. 358 pp., diagrs., charts, tables, 9¼ × 6 in., cloth, $4.50. This book is a revision and a combination of *Business Administration for Engineers* and *Legal and Ethical Phases of Engineering*. It provides engineering students with detailed discussions of various situations within these fields which they are likely to encounter in practice, and is general enough for any type of engineer. Illustrative examples and questions at the end of each chapter are those likely to be encountered by engineers.

Engineering Drawing Problems, to accompany French's Engineering Drawing, Series I. Prepared by C. D. Cooper, P. E. Machovina and C. J. Vierck. McGraw-Hill Book Co., New York, Toronto, London, 1948. No pagination, diagrs., charts, 11 × 18 in., paper, $3.50. In this set of prepared sheets and layouts are presented problems designed to cover the fundamental subjects ordinarily taught in an elementary course. The working-drawing problem is presented as a design drawing from which the student, working as a detailer, makes a complete set. Since the use of instruments is developed along with the other topics, the first orthographic problems provide useful freehand practice.

Geology Applied to Building and Engineering. By A. Bray. Sir Isaac Pitman & Sons, Ltd., London, England, 1948. 196 pp., illus., diagrs., maps, tables, 8¾ × 5½ in., cloth, 18s. Of interest to students, builders, architects, and civil engineers, this volume deals with raw materials extensively used in the building industry. A short introductory chapter on the general principles of geology is given. Other chapters deal with quarrying and mining methods, surface deposits and sites, and formation, types and uses of a wide variety of rocks and minerals.

International Association for Bridge and Structural Engineering. Mémoires, Abhandlungen, Publications. 8th Volume, 1947, published by the General Secretary in Zürich, for sale by Verlag Ag. Gebrüder Leemann & Co., Zürich, Switzerland. 310 pp., illus., diagrs., charts, tables 9½ × 6¾ in., paper, 35 Sw.Frs. Fifteen original papers are included on various aspects of steel and reinforced concrete construction. Piling, antenna masts, pipelines, suspension bridges, web buckling, stress analysis, and elastic stability are among the topics dealt with. Seven papers are written in English, six in French, and two in German, with titles, captions, and summaries in all three languages.

Latest Developments of Dams and Hydroelectric Power Stations in France. By A. Coyne. Société des Ingénieurs Civils de France, British Section, 82 Victoria St., London, S.W.1, England, 1947. 27 pp., illus., diagrs., 9½ × 7½ in., paper, 5s. In this pamphlet, modern developments in large power station dams are exemplified in considerable detail by certain French installations

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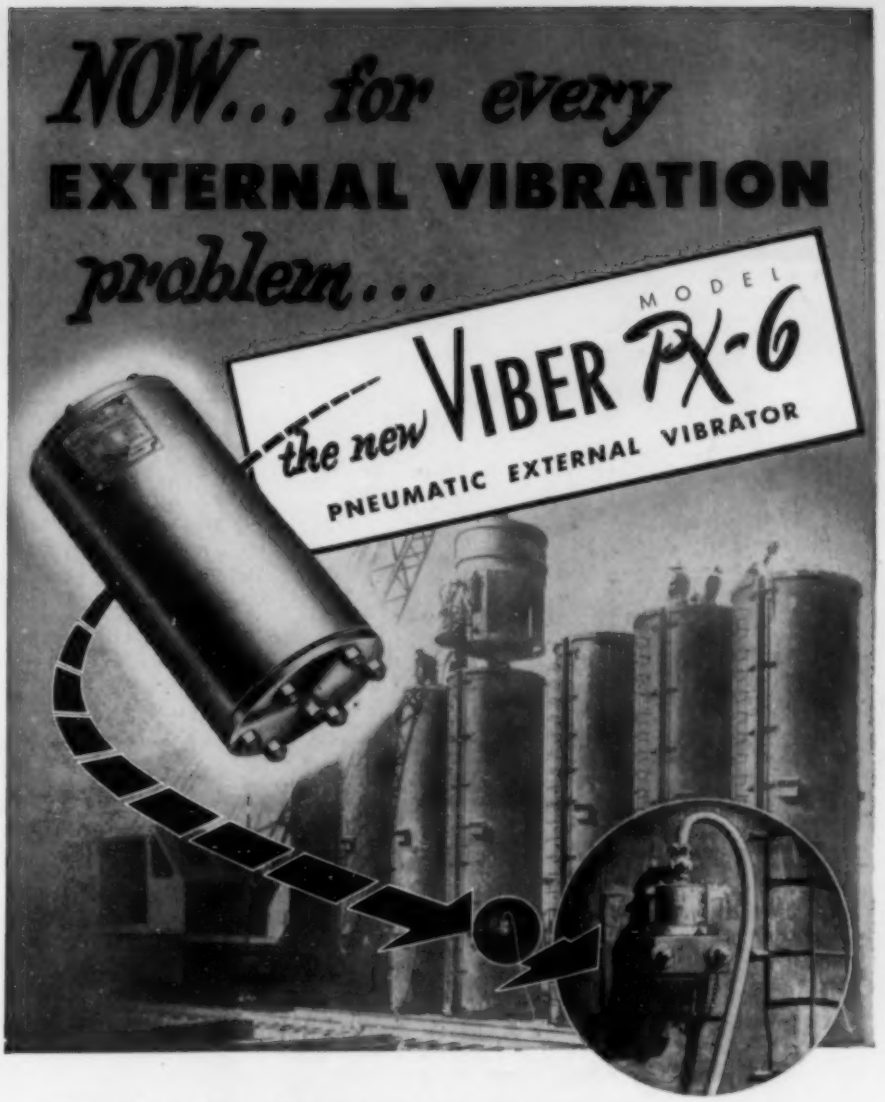

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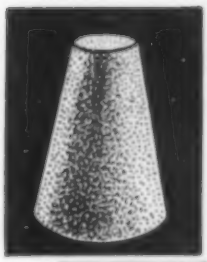

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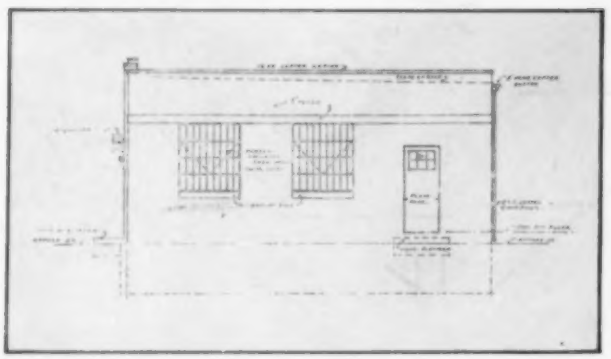

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(Continued from page 81)

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with particular reference to flood overfalls of the "ski-jump" type. The technical discussion of the paper is included.

NATIONAL RESEARCH COUNCIL, HIGHWAY RESEARCH BOARD, Proceedings of the Twenty-Seventh Annual Meeting, held at Washington, D.C., December 2–5, 1947. Edited by R. W. Crum and others. National Research Council, Washington, D.C., 1948. 523 pp., illus., diagrs., charts, tables, 9¾ × 6½ in., cloth, $7.50. Some 45 papers and reports on highway subjects are contained in the present volume of this annual publication. They are grouped under six broad headings: economics, finance and administration; design; materials and construction; maintenance; traffic and operations; soils investigations. Information on the work of the various committees and on certain awards is also given.

RAINFALL AND RUNOFF. By Edgar E. Foster. The Macmillan Co., New York, 1948. 487 pp., diagrs., 9½ × 6¼ in., cloth, $9. In providing a clear up-to-date exposition of the scientific principles and methods underlying all problems that involve the control of water, this book makes use of the wealth of hydrologic data accumulated at great expense during the past 15 or 20 years. It fully explains the new methods and data of hydrologic analysis, as well as previously established methods. Throughout, emphasis is placed on the economic utility of hydrology in the analysis and solution of practical problems of water control and the use of water resources.

REPORT ON MINING SUBSIDENCE. Institution of Municipal Engineers, 84 Eccelston Square, London, S.W.1, England, 1947. 80 pp., diagrs., maps, tables, 9½ × 6 in., paper, 5s. Summarized reports are given of damage in selected British coalfields, including descriptions of fields, types of damage, and remedial measures. Brief general notes on subsidence, stowage, structural precautions, etc., are also included. Three papers relating to various aspects of the subsidence problem are appended, together with a "Memorandum on the law relating to subsidence due to mineral workings."

SUBMARINE GEOLOGY. By F. P. Shepard. Harper & Brothers, New York, 1948. 348 pp., illus., diagrs., charts, maps, tables, 9½ × 6 in., cloth, $6. Of immediate importance to economic geologists and to students, this volume contains information on submarine canyons, continental shelves and slopes, coral reefs, waves and currents and shore lines. The economic applications, such as the oil possibilities of continental shelves are discussed. All of the latest data available are presented, including such wartime research as has been declassified. It is written in a non-technical style and is well illustrated.

SURVEYING FOR AGRICULTURAL STUDENTS AND PLANTERS. By F. R. Stewart and J. C. Grassie. The University Press, Cambridge, England; the Macmillan Co., New York, N.Y., 1948. 236 pp., diagrs., tables, 9¾ × 5½-in., cloth, $3.50. This volume deals with the principles of surveying particularly in their application to agricultural work. Their chapters on chain surveying, traversing with the prismatic compass, the box sextant and the theodolite, simple tacheometry, plane table work, leveling, the taking and plotting of sections, contouring, volumes of earthwork, setting out circular curves, and description of the instruments used in the various operations.

TABLES OF THE BESSEL FUNCTIONS OF THE FIRST KIND OF ORDERS TWENTY-EIGHT THROUGH THIRTY-NINE. (Annals of the Computation Laboratory of Harvard University, Volume 10). By the Staff of the Computation Laboratory. Harvard University Press, Cambridge, Mass., 1948. 694 pp., tables, 11¾ × 7¾ in., cloth, $10. Eighth in the series begun in 1947 with tables of the orders zero and one, the present volume continues to present the tables computed on the Automatic Sequence Controlled Calculator. Bessel functions of orders 40 through 100 are to be published subsequently. The tabulation in the current volume is carried to 10 decimal places.

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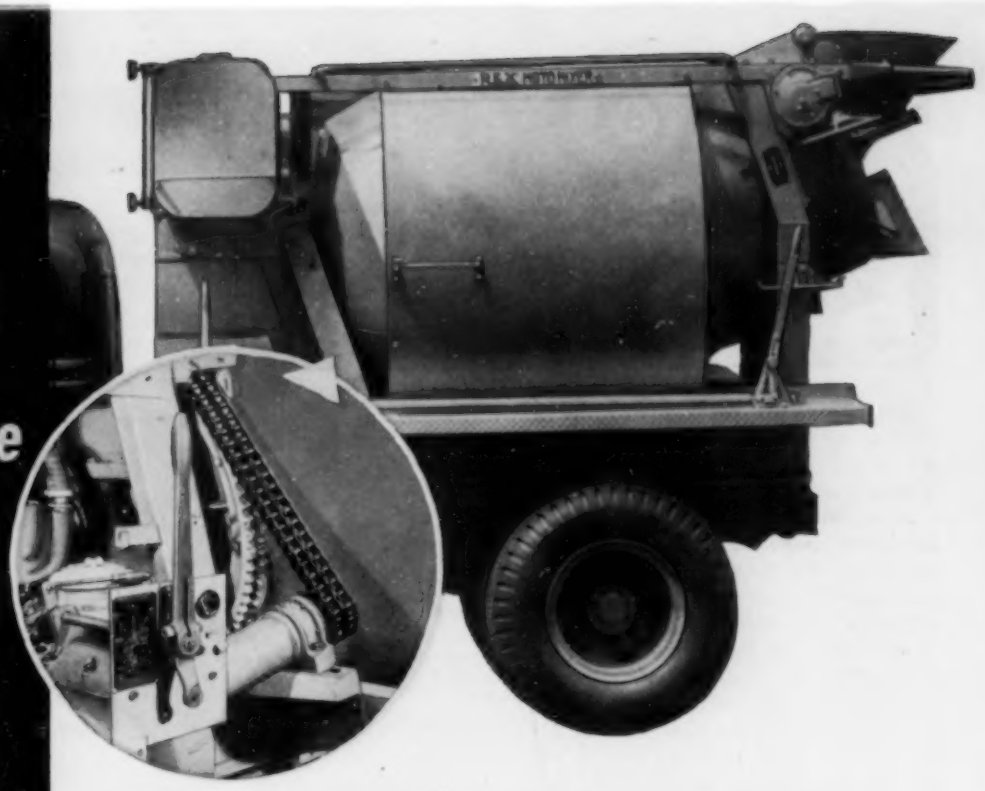

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APPLICATIONS FOR ADMISSION OR TRANSFER

January 1, 1949 — Number 1

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every Member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid it in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board. Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years
Associate Member	Qualified to direct work	27 years	8 years	1 year
Junior	Qualified for subprofessional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years

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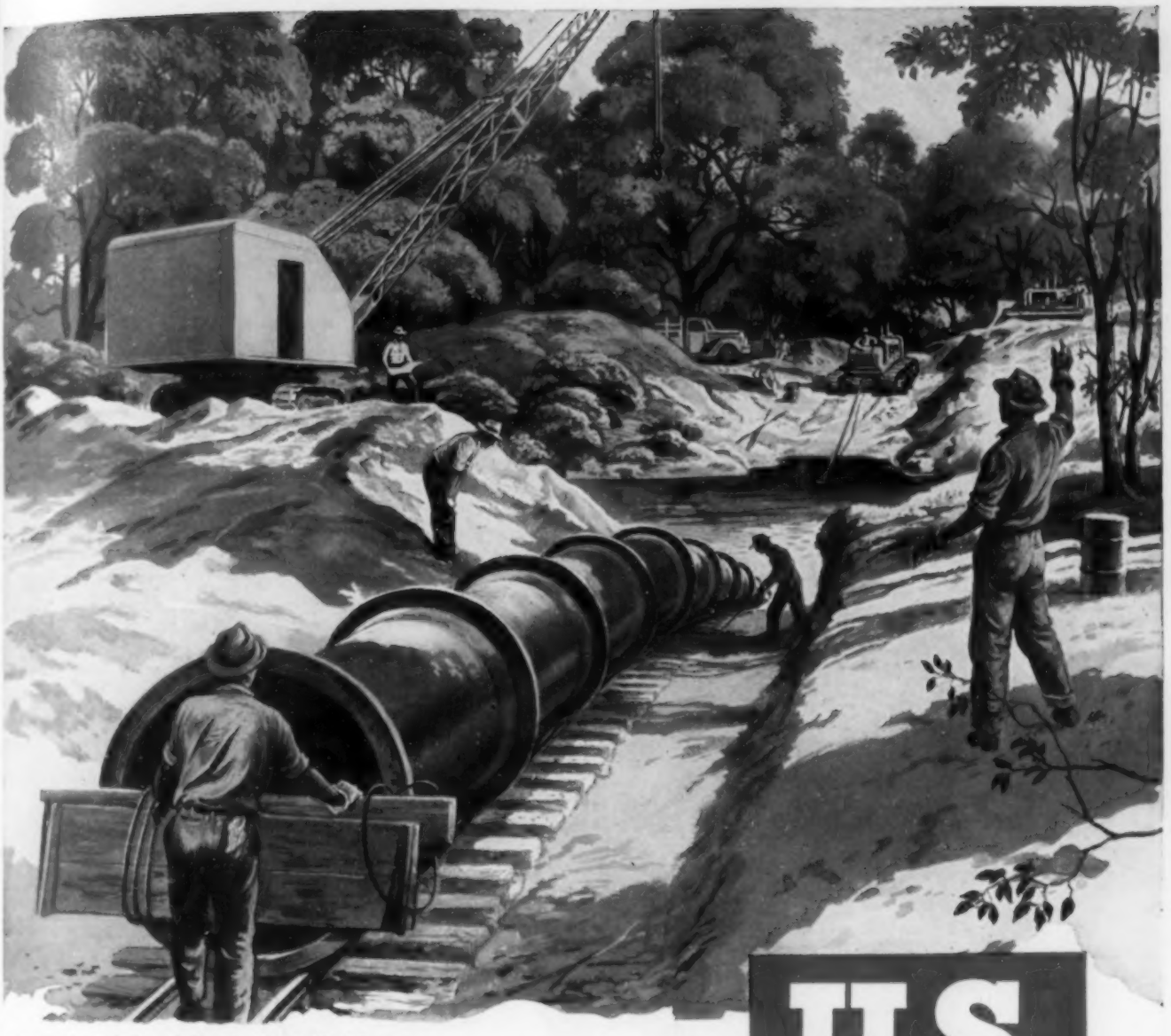

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REMEMBER — Following the inauguration, the Nation's Capital will be full of visitors. Don't delay! To be sure of accommodations, write or wire today for detailed information and official hotel application blanks.

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Men Available

JUNIOR ENGINEER; Jun. ASCE; 27; married; B.S. in engineering; various duties with Naval Construction Battalion, including inspection and administration; industrial designing experience; residential contracting, all phases from selling to execution with office partition distributor; desires non-traveling position with good future. New England preferred. C-461.

RECENT GRADUATE; Jun. ASCE; 24; single; B.S. in civil engineering from Brown University. Desires employment giving experience or training leading to structural design work. Prefers location in New England. C-462.

CIVIL ENGINEER; Jun. ASCE; 27; married; Texas registration; diversified experience: Seabees; sanitary engineering design; housing project executive. Will accept foreign or domestic employment. C-463.

ENGINEER; M. ASCE; with college and technical degrees; 40 years' experience on investigation, reports, design, and construction of aqueducts, wells, pipelines, pumping stations, water and sewage treatment plants; several years teaching; now turning over a large project for operation; open for engagement on similar work. C-464.

CAPABLE STRUCTURAL ENGINEER, M. ASCE; B.S., C.E., civil engineering; wants responsible position, offering 25 years' background in industrial, architectural, hydraulic, and indeterminate structures, design and estimate. Prefers New York City or northern New Jersey location. Registered in both states. C-465.

CIVIL ENGINEER, Jun. ASCE; 25; single; civil engineering graduate; 29 months' experience general field and office engineering, writing specifications, taking off quantities and making estimates of cost for firm engaged as consultants in municipal engineering. Desires employment with engineering concern doing construction work. Prefers Mid-West location. Available within 15 days. C-466.

Positions Available

ENGINEERS. (*a*) Designers for large sanitary and sewerage project. Must have previous experience in this work and, as it progresses, will go on with the actual construction and operation. (*b*) Sewage Chemists, with experience for same project. Salaries open. Location, Pittsburgh, Pa. Y-1769.

ENGINEERS. (*a*) Sanitary Engineer, under 45, preferably graduate, with experience in investigation, reports, design, operation of water and sewerage systems and plants; stream pollution studies; industrial waste disposal and treatment, to be responsible for sanitary engineering in small consulting engineer's office. (*b*) Structural Engineer, under 40, married, experienced in design of steel and reinforced concrete structures for bridges, industrial, sewage and water treatment plants, to be responsible for structural design in consulting engineer's office. Some traveling. Salary open, dependent upon qualifications. Write stating qualifications, date available, and salary requirements. Location, North Carolina. Y-1770.

ENGINEERS. (*a*) Assistant Construction Superintendent, with at least 10 years' contracting experience covering industrial plant utilities, roads, etc. Salary, $10,200–$11,400 a year. (*b*) Personnel Manager, with at least 5 years' experience in personnel work in construction industry. Salary, $7,800–$9,000 a year. Location, England. Y-1774.

STRUCTURAL ENGINEER, 30–45, mechanical or civil graduate, with at least 5 years' experience in mechanical or structural engineering in heavy industry, preferably in pulp and paper industry. Will make field sketches of concrete and structural steel work; from field sketches will make detailed drawings and specifications. Keep constant check on field installation. Must be qualified to

(*Continued on page 91*)

EXPERIENCED SUPERVISORY ENGINEERS

• • • •

SOUTH AMERICA

A large integrated oil company needs experienced supervisory and staff engineers of the following catagories in Venezuela.

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If interested, apply by letter giving complete employment and personal history.

ARABIAN AMERICAN OIL COMPANY
200 Bush Street Dept. "D" San Francisco, California

(Continued from page 90)

supervise work of junior draftsmen. Salary, about $5,000 a year. Location, New England. Y-1794(d).

PROFESSOR OR INSTRUCTOR, not over 45, architectural graduate, to teach courses in methods and materials of architectural construction, architectural working drawings, mechanical equipment of buildings, and graphic statics. Preferably native-born American citizen. Salary and rank dependent upon qualifications. Location, Pennsylvania. Y-1804.

TEACHING PERSONNEL. (*a*) Associate Professor of Civil Engineering, to serve as head of newly created department, with opportunity of promotion to full professorship. Starting salary, $4,500 a year. (*b*) Instructor or Assistant Professor of Civil Engineering, to teach general civil engineering courses including structures. Should have at least a master's degree. Salary, $3,000–$3,600 a year. Location, upstate New York. Y-1805.

SANITARY DESIGNERS, experienced for sanitary work. Location, Pittsburgh, Pa. Y-1815(*a*).

CIVIL ENGINEERS with considerable background in the general administration of civil engineering projects, particularly in highway and general building construction for office and field. Must accept single status for 6 months. Salary, $7,000 a year. Location, Venezuela. Y-1827(*a*).

INSTRUCTOR OR ASSISTANT PROFESSOR, preferably with master's degree. (*a*) Civil Engineering in surveying, highway, etc. Salaries for 9 months: Instructor, $2,400–$3,000; Assistant Professor, $3,100–$3,700. Location, eastern Pennsylvania. Y-1856(*a*).

STRUCTURAL STEEL DESIGNER, experienced, to design supporting steel work for transmission lines. Some detailing. Salary, $4,200 a year. Location, Pennsylvania. Y-1858(*a*).

TEACHING PERSONNEL. (*a*) Assistant Professor of Structural Engineering, to teach undergraduate classes and to participate in structural research work. Salary, $4,250 for 9 months. (*b*) Assistant Professor, graduate, master's degree, with experience including enough contact with engineering construction, so that he is familiar with the legal and economic problems and construction phases in the building of large engineering projects, to teach construction methods, engineering law, or engineering economics. Salary, $3,750 for 9 months. (*c*) Instructor in hydraulics, recent graduate. Should have interest and ability in research work and be willing to participate in the planning of new hydraulics laboratory. Salary, $2,600 for 9 months. (*d*) Administrative Assistant in the office of the director of the school of civil engineering. Should be able to plan engineering class schedules, to take minutes in the civil-engineering faculty meetings, to process applications for both undergraduate and graduate students, etc. Salary, $3,500 for 11 months. Location, upstate New York. Y-1860.

CONSTRUCTION ENGINEER, experienced in industrial work. Experience in the construction of chemical plants, oil wells, distilleries, etc., preferred. Will supervise the construction of an addition to a plant. Thereafter, will maintain this plant and also supervise the construction and maintenance of buildings. Salary open. Location, Massachusetts. Y-1878.

ENGINEERS. (*a*) Structural Engineers, graduates or licensed, experienced primarily in the design of grade-separation structures, highway and railway bridges. (*b*) Civil Engineers, young, graduates capable of some designing, but principally of detailing both structural steel and reinforced concrete structures incident to the construction of grade separations and railway and highway bridges. (*c*) Structural Draftsmen for detail drafting only, with experience in this line. Write stating qualifications. Location, South. Y-1893.

RESEARCH ENGINEER, graduate civil, 30–45, with at least 5 years' experience in highway construction and materials testing. Soils and concrete experience desirable. Unusual opportunity to conduct original research and development studies. Salary, $350–$500 a month. Location, near Chicago. R-5263.

ASSISTANT PROFESSOR, 25–40, graduate civil engineer, preferably with advanced degree, and with three to five years' experience in structural work, to teach structural engineering. Salary, $3,600–$4,500 a year. Location, Delaware. Y-1917.

ENGINEERS - DESIGNERS - DRAFTSMEN - INSPECTORS

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Senior Bridge Designers*	$4500-5400	per annum
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Sr. Bridge Inspector	3600-4200	" "
Landscape Architect	3600-4500	" "
Asst. Engineer, Highway	3000-3600	" "
Bridge Detailer	3000-3600	" "
Bridge Inspector	3000-3600	" "
Jr. Engineer, Highway	2400-3000	" "
Jr. Engineer, Laboratory	2400-3000	" "
Jr. Engineer, State Aid Projects	2400-3000	" "
Asphalt Plant Inspector	2400-3000	" "
Laboratory Technician	2160-2760	" "
Sr. Engineer Aide	1800-2400	" "
Materials Inspector	1560-1920	" "
Engineering Aide	1560-1920	" "

* Applications are also desired for Sr. Bridge Designer with experience in writing specifications.

Note: We will accept applications from qualified non-U.S. citizens on a temporary basis.

Address A. Lee Grover, Secretary, New Jersey State Highway Department, Trenton, N. J., for application blank **today.**

Charles M. Noble, State Highway Engineer

Spencer Miller, Jr., State Highway Commissioner

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(*Continued from page 88*)

VENCILL, GEORGE JUSTIN (Age 39) Chf. Hyd. Engr., Union Elec. Co. of Missouri, St. Louis, Mo.

WEIS, CHESTER FRANKLIN (Age 54) Civ. Engr. New York City Board of Water Supply, Bayside, N.Y.

WOMBLE, BYRLE BURTON (Jun.) (Age 26) Res. Engr., J. W. Shikles & Co., Kirksville, Mo.

WOODWARD, RICHARD LEWIS (Jun.) (Age 31) San. Engr. (Major), USPHS, Asst. to Chf. Field Investigation Plan, Cincinnati, Ohio.

WRIGHT, JOHN ROBERT (Jun.) (Age 36) Div. Eng. Ralston Purina Co., St. Louis, Mo.

FOR JUNIOR

BARRY, ALFRED HAMILTON (Age 25) Asst. Engr. Irrigation Dept., Vaal-Hartz Irrigation Works, Andalusia, South Africa.

DA CUNHA, VENEVERITO (Age 32) Engr., Escritorio Tecnico de Engenharia, Curitiba, Parana, Brazil.

HINSON, HERBERT GILBERT (Age 31) Asst. Hydr. Engr., P-1, U.S. Geological Survey, Water Resources Branch, Surface Water Investigations, St. Albans, W.Va.

HUSAIN, BAKHTEYAR (Age 25) Inspector of Works, The Great Indian Peninsula Ry., Bombay, India; Care, The Embassy of Pakistan.

HUSAIN INAYAT (Age 23) Extra Asst. Director, Central Eng. Authority, Govt. of Pakistan, Karachi, Pakistan.

KELLER, LEO MERLE (Age 27) Draftsman, Crocker & Ryan, Denver, Colo.

KHOSLA, MOHINDAR PERSHAD (Age 23) Deputy Engr., Public Works Dept., United States of Saurashtra (Kathiawar), Morvi, Kathiawar, India.

LANGSTED, IB AUGUST LAURITS (Age 28) With Burns & McDonnell Eng. Co., Kansas City, Mo.

LARA BUSTAMANTE, GUILLERMO (Age 30) Chf. Municipal Engr., Capital of Costa Rica, San Jose, Costa Rica.

MCMILLAN, RAYMOND (Age 22) With C. H. Martin, Ltd., Contrs., Kingswood, So. Australia.

OTOVA R., JOSE E. (Age 32) Private practice, design and construction of water-supply and sewer systems, Cauca Valley, Cali, Colombia.

PARCHER, JAMES VERNON (Age 28) Asst. Prof. of Civ. Eng., Oklahoma A. & M. Coll., Stillwater, Okla.

RADLEY, GUY FLAGG, JR. (Age 25) Associate Civ. Engr., Humble Oil & Refining Co., Tyler, Tex.

STRONG, WALTER IRA (Age 31) Structural Draftsman, Jackson & Moreland, Boston, Mass. Wellesley Hill, Mass.

TEMPLE, PAUL BLAKE (Age 24) With A. G. McKee & Co., 2300 Chester Ave., Cleveland, Ohio.

WALTENSPIEL, EDMUND JOSEPH (Age 26) Sales Engr., Armco Drainage & Metal Products, Inc., Phoenix, Ariz.

UNIV. OF ALA. (Age)

CZERKAWSKI, JOSEPH JOHN, 1948 (23)

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STRATTON, RALPH MERRITT, 1948 (26)

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PFEFFER, MURRAY BARNARD, 1948 (22)

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PHILIPSON, BRUCE GLUECK, 1948 (21)

UNIV. OF COLO.

LAZELL, EDWARD WILLIAM, JR., 1948 (20)

COLUMBIA UNIV.

STEIN, JOSEPH, 1948 (21)

COOPER UNION

GARRISON, WALTER EDWARD, 1948 (27)

DUKE UNIV.

WILHOITE, GENE MILTON, 1948 (23)

UNIV. OF FLA.

DEWINELER, AUGUST, JR., 1948 (23)

GEORGE WASHINGTON UNIV.

HENNESSY, VINCENT HARRY, 1948 (24)

GA. INST. TECH.

CARTER, MELVIN WHITEHEAD, 1948 (22)
KENNY, EDWARD PATRICK, JR., 1948 (22)

(*Continued on page 93*)

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PARRISH, HENRY PARKER, 1948 (32)
SPARKS, GEORGE HARTMANN, JR., 1948 (24)
WEBBE, CHARLES WILLIAM, JR., 1948 (26)
WOODWARD, HENRY ERNEST, 1948 (22)

UNIV. OF ILL.

ANDERSON, FRANK WILLIAM, 1948 (23)
BADIR, MOUNIR, 1948 (26)

UNIV. OF KANS.

BORENE, ROY KENNETH, 1948 (26)
SCIANDRONE, JOSEPH CARL, 1948 (24)

LEHIGH UNIV.

DETURK, RICHARD SNYDER, 1948 (22)

LA. STATE UNIV.

HARRISON, LAMAR PRIESTLEY, JR., 1948 (24)

MASS. INST. TECH.

GRANDE, RENATO EVANGELISTA, 1948 (22)

UNIV. OF MICH.

RIDA, ISHAK ALI, 1948 (28)

UNIV. OF MINN.

CARLEY, DONALD OLIVER, 1948 (24)

UNIV. OF MISS.

HAMRIC, EDWARD, 1948 (25)

UNIV. OF NEBR.

HERVERT, GEORGE EDWARD, 1948 (27)

UNIV. OF N. MEX.

OLSON, CARL ARVID, 1948 (22)

COLL. OF CITY OF N.Y.

GERSHEN, ALVIN EDWARD, 1948 (22)
LERMAN, NORMAN I., 1947 (23)

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BERTRAM, RICHARD ELGAR, 1948 (23)

OKLA. A. & M. COLL.

TOLER, RICHARD GRANT, 1948 (31)

UNIV. OF PITTSBURGH

RAPP, ROBERT ALBERT, 1948 (23)

ROSE POL. INST.

BACKES, WILLIAM EDWARD, 1948 (24)
COONEY, ROBERT JAMES, 1948 (27)
CREWS, RONALD EUGENE, 1948 (23)
ESHELMAN, CHARLES VERNOR, 1948 (26)
HAUPT, CASPAR WISTAR, JR., 1948 (25)
KADEL, THEODORE WARREN, 1948 (24)
McDAID, RICHARD JOHN, 1948 (22)
McFARLAND, RICHARD SCOTT, 1948 (22)
MOTSINGER, CLAIBORNE, 1948 (22)
NASH, ROBERT JOSEPH, 1948 (26)
RUBLE, FREDERICK ROLLAND, 1948 (23)
YEE, ALFRED ALPHONSE (23)

SO. METHODIST UNIV.

ALLEN, LYNDON CRANE, 1948 (26)

STANFORD UNIV.

MELTZER, ABRAHAM JAMES, 1948 (26)

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LEGRAND, HUDSON TAYLOR, JR., 1948 (28)

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SMITH, CECIL HIAWATHA, 1948 (24)

TULANE UNIV.

RODY, WALTER WILLIAM, 1948 (22)

VANDERBILT UNIV.

MOORE, CECIL ULRIC, JR., 1948 (25)

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MEYERS, RICHARD JAMES, 1948 (21)
MORRELL, JOSEPH, 1948 (24)

UNIV. OF WIS.

LORD, RICHARD HERBERT, 1948 (24)
SLATER, JOHN GEORGE, 1948 (22)

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EQUIPMENT, MATERIALS *and Methods*

NEW DEVELOPMENTS OF INTEREST, AS REPORTED BY MANUFACTURERS

Scoop Loader

A NEW FRONT END loader attachment has just been announced. It is claimed to be a very useful and profitable attachment for the use of contractors, street, highway, and airport departments. The loader is designed for quick easy attachment to the Galion No. 402 maintenance motor grader. Lifting operation is by hydraulic power under finger-tip control from the grader seat. Operation is independent of scarifier. Loaded bucket is tripped by manual cable control. It is stated that when the scoop

Scoop Loader

is attached to the grader it is possible to windrow dirt or snow, scoop it up, and load on trucks in one continuous operation—thus cutting down idle time of the grader as well as accomplishing work ordinarily requiring a separate piece of expensive equipment. The loader also has other uses such as handling sand, cinders, and other material from stock piles. **The Galion Iron Works & Mfg. Co., Marion, Ohio.**

Soil Compactor

THE VIBRO-PLUS vibratory soil compactor is a vibrating soil-packing machine of a special type meant for packing of road and railway banks, backfills, earth dams, base courses for airfields, compactions under floors and grounds, etc. The compactor has a solid vibrating base plate in direct contact with the soil. The vibrator element which is hinged to the base plate contains two excenters which rotate synchronously in opposite directions, where by so-called directed vibration movement is obtained. The machine is driven by a diesel engine of about 10 hp which is mounted on an elastically suspended plate. The total weight is about 3,300 lb. The machine can be operated by hand, using its own vibratory force or can be tractor drawn. **Vibro-Plus Corp., 243 W. 55 St., New York 19, N. Y.**

Equipment for Heavy Length Loads

THE TOURNAHAULER, a 45,000 G.V.W. vehicle is designed to haul heavy length loads such as pipe, timber, steel, etc. This machine follows the company's tradition of incorporating operating characteristics that not only enable it to navigate the mire, sand and grades and sharp turns of off-road travel but also to travel on the highways. Tests recently completed prove that the Tournahauler will do all it is designed to do and more. 26,000-lb. pipe loads were pulled through mud conditions so severe that the rear wheel hubs were submerged. Under such soft difficult ground conditions the Tournahauler carried pipe up steep grades, into a sharp turn and on to the job, a situation that had only been negotiated previously with the help of auxiliary equipment under extreme difficulty. Extra large, low-pressure tires afford the flotation that helps the machine get through under such tough hauling conditions. With this piece of equipment, necessary loads can be moved to the job even during rains that would normally wash out operations. **R. G. LeTourneau, Inc., Longview, Tex.**

Hollow-Metal Entrance Doors

A NEW DESIGN in Fenestra stock, hollow-metal entrance doors has been announced by Detroit Steel Products Co. and the doors are now available for use in offices, apartments, stores, gas stations, schools, theaters, etc. Furnished in one standardized size—3 × 7 ft—the doors may be used in single or double openings and are supplied with a standard cylinder lock. Attractive bronze push and pull bars and bronze ball bearing hinges are available if desired. The doors may be hinged right or left to swing in or out. The doors come complete with frames and hardware machines, fitted and ready to assemble, saving installation time for builders. Complete details and specifications are available by writing **Detroit Steel Products Co., 3139 Griffin St., Detroit 11, Mich.**

Pneumatic Paving Breaker

A NEW 70-LB PNEUMATIC paving breaker is announced. The new Thor "24" paving breaker is a companion machine to the widely used Thor 84 lb breaker the Model "25", and answers a demand for a demolition tool just under the heavy duty class. The new Thor breaker has a 28 in. over-all length; $1\frac{1}{2} \times 6$ in. chuck sizes for collared steels; $\frac{3}{4}$ in. hose size; and $\frac{3}{4}$ in. hose inlet pipe thread. Write for full information to **Independent Pneumatic Tool Co., 175 State St., Aurora, Ill.**

Electric Portable Compressors

ELECTRIC PORTABLE compressors in 60, 105, 160, 210, and 315 cfm capacities are available in skid, 2-wheel trailer, and 4-wheel trailer mountings. The new units will be known as Air Chief "Electrics" and they will serve as a companion line to Davey's gasoline and diesel models. The compressors are of two-stage construction with intercooler and safety valve. They are direct driven from 1,200 rpm, 220 to 440-volt a-c motors of squirrel cage, horizontal type. Motor starters are full voltage, a-c magnetic non-reversing, standard sheet steel NEMA type 1, 3-phase, 60-cycle, with heaters for motor protection. **Davey Compressor Co., Kent, Ohio.**

New Cable-Controlled Earthmoving Equipment

THREE NEW MODELS of cable-controlled earth-moving equipment are currently in production at the Wooldridge Mfg. Co. These include the Models BB-85 and BB-120 four-wheel scrapers and the BHD-19 bulldozer. Offering a wide, unobstructed front apron opening of 60 in. the new scrapers feature rear-draft fulcrum leverage and pivot-tilt bowl to assure faster, more efficient loading and dumping of greater volume. Other engineering advances include higher yoke clearance and greater ruggedness throughout. Cable is easily accessible, reeved in straight lines without reverse bends for increased life and easy replacement. Shorter wheelbase insures quick turning in crowded quarters. All sheaves are mounted away from dirt and load. The BHD-19 bulldozer for

Cable Controlled Earthmover

Allis-Chalmers' big HD-19 tractor is designed for rugged service in straight bulldozing operations. Heavy push arms, fabricated from formed channel, telescope for knock-down shipment. Cable to power control unit follows side of tractor frame from a sturdy engine-mounted assembly, providing operator with full visibility. **Wooldridge Mfg. Co., Sunnyvale, Calif.**

Concrete Coloring

IN A DETERMINED EFFORT to reduce traffic accidents along heavily traveled highways, the California State Highway Department has approved the application of concrete coloring to sections of the new Cabrillo Freeway entering San Diego. The coloring is applied to highway leadoffs, thus making them more easily visible to approaching motorists who are thereby given ample time to get into the proper lane. Application of Kemiko to Cabrillo

Concrete Coloring

Freeway, San Diego. Leadoffs have also been stained. The coloring material used on the job was Kemiko concrete stain which through extensive tests was found to offer extended visibility, reduction of glare, and extreme durability despite heavy highway traffic. An important feature of the coloring material is that it is not a surface paint but a chemical solution which penetrates the pores and through chemical reaction becomes a permanent part of the concrete itself. Interested highway department and construction engineers can receive more detailed information from **Rohloff & Co., 918 N. Western Ave., Los Angeles 27, Calif.**

"Handy Andy" Dozer

A "MIGHTY MIDGET" now being introduced to the excavating industry is the new "handy andy" angle dozer. Powered by a gasoline engine, the new dozer stands only 3½ ft. in height, with an over-all length of 7 ft. Three speeds forward and reverse, and a 6 ft. turning radius enable it to take all clean-up work, back-filling, road maintenance, slag leveling, towing, pushing, and other excavating tasks right in stride. A special tilting front axle and

"The Mighty Midget"

hydraulic-powered front wheel steering enable it to maneuver into narrow areas and panelways, and do a fast, efficient dozer job. And, by being "tailored" in power and maneuverability to the many duties it must perform, this dozer has proven to be extremely economical to operate. The steering controls, brake, and clutch are hydraulically controlled separately off the pump on the main shaft. Every part of the dozer is readily accessible for fast servicing and easy maintenance. **The Central Mine Supply Co., Mt. Vernon, Ill.**

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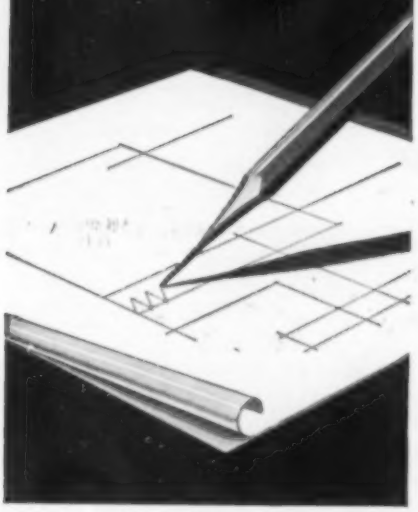

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A NEW AND IMPROVED rotary concrete drill with exclusive design features that make possible a substantial cost-per-hole saving is announced. Because of its unique core drill design and a side exhaust slot which permits core particles to escape, the Tilden drill penetrates concrete at the rate of 2 in. or more per min in diameters of from $\frac{1}{4}$ to 2 in. Specially-treated sintered carbide cutters, located around the perimeter of the core where they operate at the most efficient speed, exert a quiet, pulverizing action which drills holes faster and leaves them straighter and cleaner. By reducing labor time per hole to a fraction of that consumed by other methods, the Tilden drill effects an important saving in electrical work, plumbing, heating, air conditioning, sign hanging, and many kinds of maintenance and installation work. The Tilden drill bit is designed for use with ordinary electric drill motors. Glass, steel, and rock, when imbedded in concrete are easily drilled with the tool. The cutters can be resharpened on any ordinary grinder used for tungsten carbide. **Tilden Tool Mfg. Co., 1995 N. Fair Oaks Ave., Pasadena 3, Calif.**

Work Positioner

A NEWLY DESIGNED motor-operated work positioner, driven by a hydraulic variable speed transmission and a $\frac{1}{3}$ hp single-phase AC motor, has been introduced by Ransome Machinery Co., subsidiary of Worthington Pump and Machinery Corp. The positioner, known as Model I-P, has a load capacity of 100 lb. By its use, production is increased up to 50 per cent because all welds are made in the down-hand position. The table top on

Work Positioner

Model I-P rotates 360° at variable speeds, adjustable from 0–5 rpm in either direction. It is manually tilted through 135° and locks at any degree of tilt by means of a worm-and-segment. The positioner is ideally suited for such operations as welding, hard surfacing, assembling, repairing, grinding, and similar operations, because it places the work in a position most convenient for the operator. For full details and specifications, write for Bulletin 224-P. **Ransome Machinery Co., Worthington Pump & Machinery Corp., Dunellen, N.J.**

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New Roof Tile

A NEW ROOF TILE, developed by American Structural Products Co., was commercially introduced a few months ago. It is a white cellular compound of calcium silicates. Produced in slabs $2^3/_8$ in. thick, it weighs about 5 lb per square foot. The lightweight tile combines structural strength with high insulating and fireproofing factors. An electric power saw cuts

New Roof Tile

the roof tile to fit odd shapes and sizes. The new material can be cut, shaped and nailed with ordinary tools. Each 18 × $35^1/_4$ in. tile is slipped into place in the channels framed by vertical stems on the sub-purlins. This operation, performed by common labor, forms a deck on which workers may immediately walk or wheel materials. Because each tile weighs only 23 lb, it is easily handled by workmen. **American Structural Products Co., Sub. Owens-Illinois Glass Co., Toledo, Ohio.**

Hard Surfacing Powder

AN IMPROVED HARD surfacing powder, called Surfaceweld A, has been made available by the Lincoln Electric Co. The powder, to be applied with a carbon electrode, is used for depositing a thin chromium carbide type of hard surface that is highly resistant to abrasive wear and corrosion. One of its outstanding characteristics is its ability to be used with an AC arc with a single carbon electrode. It may also be applied with a twin carbon arc or may be used with DC, carbon electrode negative. It is used in preference to hard surfacing electrodes for certain conditions of severe abrasion. The powder forms a paste when mixed with water which adheres to flat and curved surfaces. The advantages of the powder form may be used on such jobs as maintaining the cutting edge of mixing blades, drill bits, surfacing augers, dipper teeth, bucket lips, forming dies, cement block formers, scraper blades, and cableway drums. **The Lincoln Electric Co., Cleveland 1, Ohio.**

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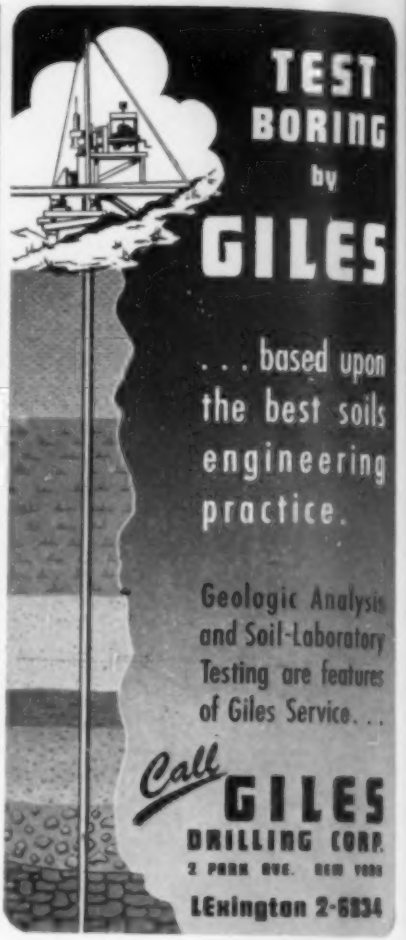
A NEW HEAVY DUTY torque bar which, according to the manufacturer, is many pounds lighter and therefore more easily handled than previous types, has just been announced. Extreme accuracy and ruggedness is claimed in torque ranges from 200 to 600 ft-lb. The bar is pre-set for specific torque requirements within its range. Then, in operation, when the desired torque is reached a loud "click" is heard. Simultaneously, a small button in the handle taps the operator's hand. Thus both "sound" and "touch" signals are given while the necessity for visual attention and consequent possibilities of misreading are eliminated. The bar is available with or without detachable head or with special heads built to the customer's specifications. The standard head is a reversible 3/4 in. square drive rachet type which operates with equal efficiency in either direction. Construction of the bar and head is of chrome molybdenum. The bar is chrome plated with rubber cushioned handle wrapped with plastic tape. Truss rod is stainless steel. A simple adjustment in the handle provides for varying torque settings. **Richmont, Inc., 2810 E. 11 St., Los Angeles 23, Calif.**

Corrosion Preventative

MANY MUNICIPALITIES use salt advantageously to aid in snow and ice removal. However, the corrosive effect of salt on cars, bridges, guard rails, and other metal structures has been a problem in the past. Research men of a Pittsburgh firm have learned that when Banox, a chemical, is mixed with salt, a microscopically thin but protective film is formed over both rusted and clean metal. This film is tough and flexible and continuous, although invisible to the naked eye. It forms in the joints and everywhere the salt reaches and continues to give protection. The chemical is non-toxic, odorless, harmless to the skin, eyes and clothing, as well as to plants and trees, and will not harm or discolor the auto paint finish. **Calgon, Inc., Pittsburgh, Pa.**

Literature Available

CORROSION-RESISTANT CONCRETE—A new booklet, "Lumnite Concrete Floors—Corrosion-Resistant & Heat-Resistant," has just been published. The detailed information contained in this booklet brings up to date the service experiences and late developments in the rapidly growing field of corrosion-resistant concrete. The brochure covers both the methods and materials used in placing this concrete in a wide variety of industrial applications. Typical uses of the product are listed for many industries. The concrete is being successfully used in lining stacks, oil refinery vessels and drainage systems. **Lumnite Div., Universal Atlas Cement Co., 135 E. 42 St., New York 17, N.Y.**



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Literature Available (Cont.)

CONSTRUCTION EQUIPMENT—A 16-page 2-color booklet, Bulletin No. 2245 gives detailed information on a complete line of equipment for concrete paving of roads, streets, and airports, ready mixed concrete plants and general concrete construction. Illustrations, specifications, charts, and dimension data are included in this invaluable offer. **Blaw-Knox Div., Blaw-Knox Co., Pittsburgh, Pa,**

FLUORINE CORROSION—A 4-page technical report on fluorine corrosion, is being offered in reprint form. It discusses high temperature attack on metals by fluorine and by hydrogen fluoride and on the resistance of nickel, monel, and other materials to these corrosive agents at various temperatures. It is illustrated by charts and includes a table of rates of corrosive attack on the materials discussed. **The International Nickel Co., Inc., 67 Wall St., New York, N.Y.**

SNOW LOADER—An attractive, 2-color, 8-page brochure graphically describes operations and features of the new Barber-Greene Model 522 snow loader. Controls, various operating features, and principles are adequately described. This booklet presents facts and figures to illustrate how the machine can pay for itself. Providing a practical means of drastically cutting snow removal costs for small towns, cities, and industrial plants, the snow loader is a one-man machine. It requires a minimum initial investment and can be converted to an all-season bucket loader at a negligible cost. **Barber-Greene Co., Aurora, Ill.**

CALCIUM CHLORIDE EFFECTING CEMENT—A new 40-page booklet, of interest to architects, engineers, and others concerned with specifications, design, or production of Portland cement concrete, has been issued. This new book condenses from research and technical reports the effects of adding measured quantities of calcium chloride to Portland cement mixes. It contains tables, graphs, and charts covering setting time, early strength, curing, slump, density, surface wear, shrinkage, and ultimate strength. Also shown are effects of varying temperatures and cold weather. **Solvay Sales Div., Allied Chemical & Dye Corp., 40 Rector St., New York 6, N.Y.**

PLUG VALVE BOOKLET—Consisting of 16 pages, fully illustrated, and amply provided with dimensional drawings, tables, and descriptive matter, a new catalog covers the complete line of Porter lubricated plug valves. A feature of the catalog is a full-page cross-section view of the valve which, with the accompanying explanation, gives a remarkably clear description of the valve's advantages. The tables contain, in addition to dimensions and list prices, all pertinent data, such as size of lubricant stick, size of adaptor for pressure-gun lubrication, size of wrench and locking device, and weight of the valve. **H. K. Porter Co., Inc., 7001 W. 66th Place, Chicago 38, Ill.**

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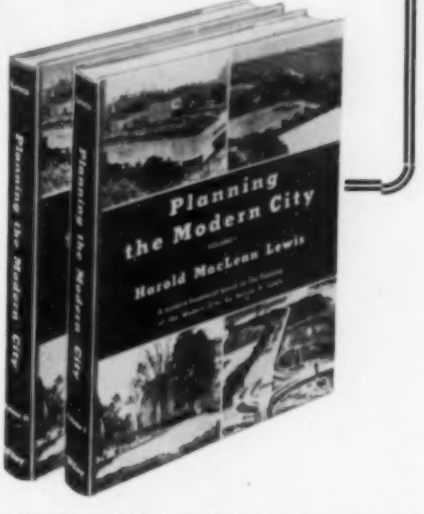

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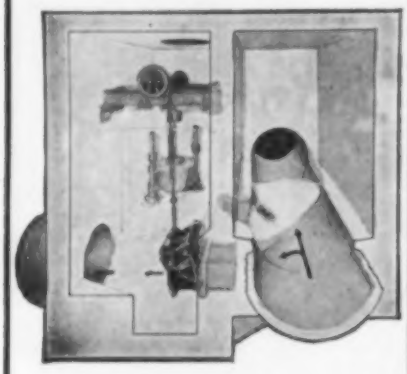

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WICKWIRE ROPE—The new wickwire rope catalog offers a different approach to this difficult subject. New charts, tables, drawings, and photographs were included to present a fresh slant on wire rope. The catalog has three indexes that permit quick reference to the contents. The first section covers the characteristics of wire rope. The second section has been divided into six parts describing wire rope for specific industries. The third section deals with the highly important subject, the care and handling of wire rope. **Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., 500 Fifth Ave., New York 18, N.Y.**

CONTRACTORS' PUMPS—Covering a full line of self-priming centrifugal contractors' pumps, this 16-page bulletin, No. 8CP-11, describes the new and startling Gorman-Rupp self-priming feature. This priming action is explained and illustrated by "X-Ray" pictures showing what goes on inside the pump. With each illustration is a description, specification, and rating of each pump. The last pages are devoted to a section covering information on how to select the correct size pump and valuable engineering data to assist contractors in solving their problems. **The Gorman-Rupp Co., Mansfield, Ohio.**

CRANE AND SHOVEL STANDARD—A recommended commercial standard for power cranes and shovels has been submitted to producers, distributors, and users for acceptance according to an announcement of the Commodity Standards Div. of the National Bureau of Standards. The purpose is to provide uniform methods of supplying specification data, requirements, and definitions for fair competition and a better understanding between buyers and sellers of power cranes and shovels. The standard applies to cranes and shovels of the convertible full revolving types. Provision is made for certifying material conforming to the recommended standard. **Commodity Standards Div., National Bureau of Standards, Washington 25, D.C.**

AIRPORT LIGHTING AND DISTRIBUTION—A new 50-page booklet gives complete information on this subject. Detailed lighting plans and wiring diagrams for typical airports are included in the book to assist airport executives in planning a new field or improving an old one. Other sections cover all Westinghouse lighting and distribution equipment. The equipment is keyed by symbols to the lighting and wiring diagrams and a simple runway equipment chart facilitates selection. Other sections cover wind instruments, engine starters and a new approach lighting system, a remarkable landing aid. **Westinghouse Electric Corp., P.O. Box 868, Pittsburgh, Pa.**

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